Czech University of Life Sciences Prague

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Diploma Thesis

Smart agriculture irrigation system powered by solar energy

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Abstract

Smart agriculture irrigation system powered by solar energy was set up and tested along with monitoring the data and analyzing the various aspects of the system.

The energy needs are increasing with time and the solar power can be one such viable solution to that. Irrigation is one of the chief parts of agriculture and solar powered irrigation systems are a relief for farmers in various ways.

Evolution of the Internet of Things (IoT) has enabled us to fetch information from various devices like sensors, farm, etc. and information can be stored remotely and by means of this, various solar energy resources across different places can be observed as well as operated remotely. In various regions with arid climatic conditions along with shortage of water as well as power, solar energy for the purpose of irrigation serves to be a good alternative. The system consists of various sensors and many different units connected to the solar cell, like the Data Acquisition Unit along with a controller with Wi-Fi connectivity and the controller monitors the moisture along with the humidity in the soil along with reading the water levels. Various design criteria's have been utilised in this system and the various sensors used were successful in serving their purpose. Also, in controlling the system remotely, the mobile application was tested which was utilised to monitor the water flow.

The readings from the prototype system were taken and got the advantages and drawbacks of the systems along with any possible upgrade that could be made in either of the systems to enhance the output. The present crisis in energy for the farmers especially those in remote regions with water and power scarcity and shows how the proposed solution can serve to be a better alternative. By reduction in the utilization of grid power, this system also enables the economic use of electricity as well as helps in the sustainable usage of water resources by minimizing the wastage.

Keywords: Smart Irrigation, Internet of Things(IoT), Solar power, Solar pump, Sensors, Automated Irrigation System, Solar pumping system, Water Management, Grid power, Nodemcu ESP8266, Soil Monitoring, Smart water dripping system.

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Abstrakt

Byl vytvořen a otestován inteligentní zavlažovací systém pro zemědělství poháněný solární energií spolu s monitorováním dat a analýzou různých aspektů systému.

Potřeba energie se časem zvyšuje a solární energie může být jedním z takových životaschopných řešení. Zavlažování je jednou z hlavních částí zemědělství a solární zavlažovací systémy jsou pro zemědělce úlevou různými způsoby.

Vývoj internetu věcí (IoT) nám umožnil získávat informace z různých zařízení, jako jsou senzory, farmy atd., A informace lze ukládat na dálku, a díky tomu lze také pozorovat různé zdroje sluneční energie na různých místech ovládané na dálku. V různých oblastech se suchými klimatickými podmínkami spolu s nedostatkem vody i energie je solární energie pro zavlažování dobrou alternativou. Systém se skládá z různých senzorů a mnoha různých jednotek připojených k solárnímu článku, jako je jednotka pro sběr dat spolu s ovladačem s WiFi připojením a regulátor sleduje vlhkost spolu s vlhkostí v půdě spolu se čtením hladin vody. V tomto systému byla použita různá konstrukční kritéria a různé použité snímače úspěšně sloužily svému účelu. Při dálkovém ovládání systému byla také testována mobilní aplikace, která byla využívána ke sledování toku vody.

Odečty z prototypového systému byly převzaty a získaly výhody a nevýhody systémů spolu s jakýmkoli možným upgradem, který by bylo možné provést v kterémkoli ze systémů pro zvýšení výkonu. Současná energetická krize pro zemědělce, zejména v odlehlých regionech s nedostatkem vody a energie, ukazuje, jak může navrhované řešení sloužit jako lepší alternativa. Snížením využití energie ze sítě tento systém také umožňuje ekonomické využití elektřiny a pomáhá při udržitelném využívání vodních zdrojů minimalizací plýtvání.

Klíčová slova: Inteligentní zavlažování, internet věcí (IoT), solární energie, solární čerpadlo, senzory, automatický zavlažovací systém, solární čerpací systém, vodní hospodářství, síťová energie, Nodemcu ESP8266, monitorování půdy, inteligentní systém kapání vody

Objectives and Methodology

Objectives

The main objective of the thesis is to design a smart agriculture irrigation system powered by solar energy to meet the increasing demand for energy in the field of agriculture using solar energy for farmers.

Partial objectives are:
- To analyze the current approaches in smart agriculture.
- To analyze the possibilities of solar-powered devices in agriculture.

- To analyze the possibilities of sensor equipment for soil analysis.
- To evaluate the proposed solution and to make recommendations.

Methodology

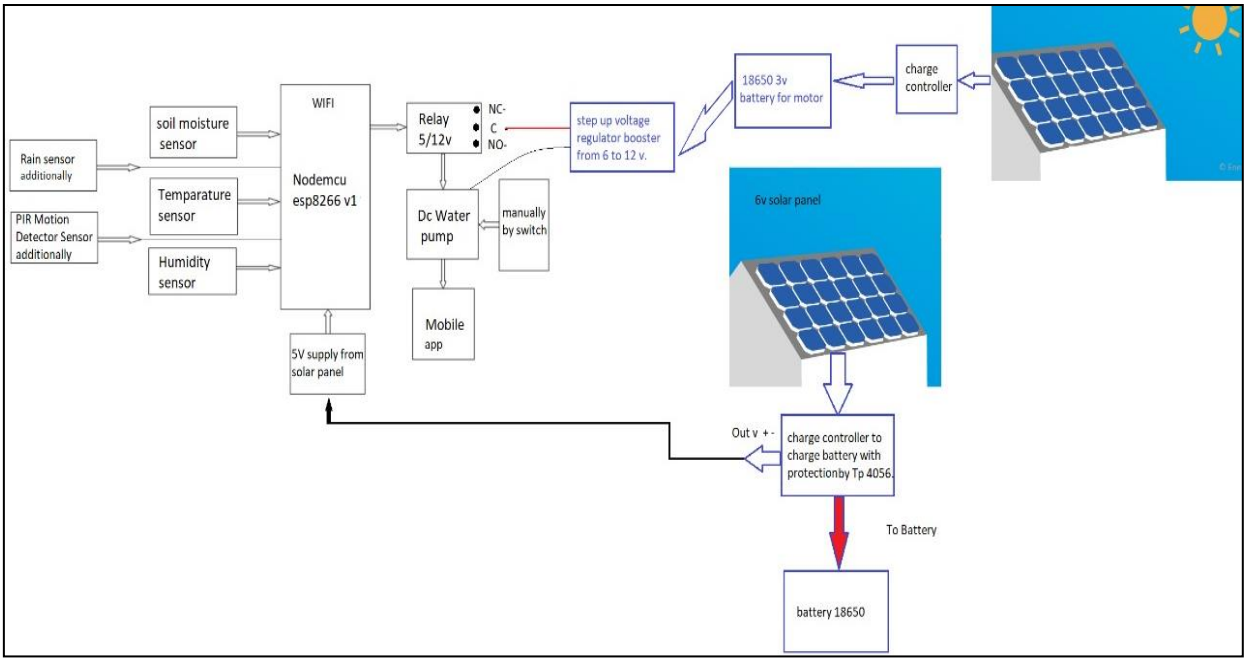
The review of the topic is based on a significant review of scientific and expert literature. The data is collected from various articles, a case study of Solar Powered Irrigation Systems (SPIS) Technology, Economy, Impacts. The qualitative data to be used in the study comprises drip irrigation, solar energy, nutrition balance, sunlight effectiveness, aggregate water supply technique, project realization phases including investment plan, etc. to analyses usage of smart devices to grow crops/animals in weather conditions. Through this, the smart device's performance was analysed and evaluated so that any conclusions can be reached with recommendations for better implementation, based on current trends. Any problem areas that need to focus on various evaluation measures and the farming sector have been researched so far.

Practical part

Overview of SPIS in India

Agrarian fields of farmers are normally might be found miles away from their home. Once in a while, farmers need to make a trip to their horticultural field many occasions in a day to begin and stop water pumps for water system. They can't watch or protect the crops against rainfall or heavy wind time or season. To eliminate these viable hardships, a framework is intended to deal with this multitude of issues consequently.

From the server, information can be acquired and seen on the Android phone or desktop. Then, at that point, the control signal is consequently shipped off the coordinator node from the Android application. At whatever point the end Device gets a sign from the coordinator node or node, it acts as per the got signal whether the motor is on or off.



The overall working block diagram is demonstrated in fig.

(Source owner)

Experiment

The proposed work has been customized programmed utilizing Arduino programming. DHT11 sensor is utilized to gather the data about the humidity and temperature. It is utilized on account of cost viability and quick reaction while checking the temperature and humidity data information.

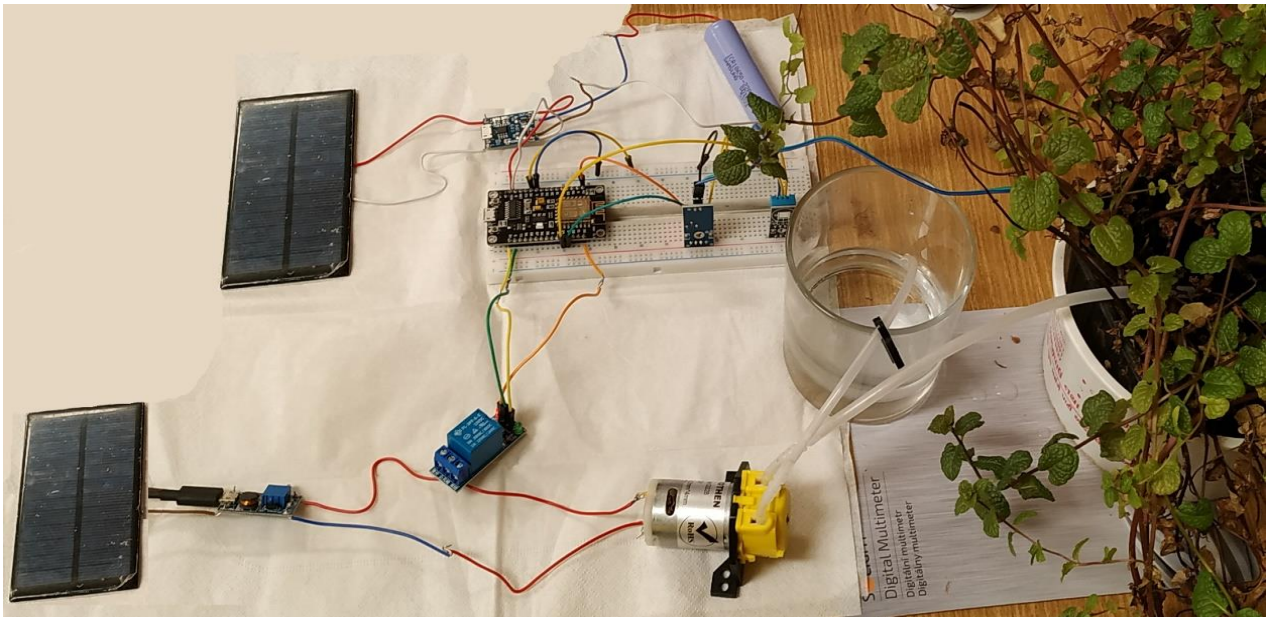


Figure 8: Prototype of Smart agriculture irrigation system

Sensors are utilized to screen the horticulture field in continuous situations. The sensors are associated with the module.

According to the calculations and readings taken on average 3 days, one acre land requires approximate 20,000 litres which on approximate one day is around 6666.7 litres. It has been analysed that 10 square meter land which is approx. to 0.00247105-acre land needs 16.5 litres of the water every day. Therefore, according to the calculations, this much amount of water is being needed to irrigate the land of 10 square meters within a day. According to the chart above, when dryness in soil is up to 800, pump will be start automatically and when it reaches to 500 to 400 it will be turning the motor to stop the flow of water in the field, by blynk app monitoring. Another advantage of this work is the pump used to recycle water back to the water tank. Above discussion and results states out that this kind of project can help out in saving up the large consumption of water in the case of flood irrigation to the crops. It is the smart based methodology used through application where the water is used as per the requirements and within limitations as well. As per the total methodology and procedure to utilise the water for the same operations can allow the irrigation to be conducted in helpful way and utilise the saved water for different purposes. Hence, present scenario of saving the water and minimising its consumption can be encouraged through these kinds of smart technology and therefore fulfil the objectives in effective and efficient manner.

conclusion

From the above discussions and explanations, it can be concluded that by implementation of this Smart Agricultural Irrigation System powered by Solar Energy, there have been various advantages for the farmers as well as for the governments. As per the calculations done, it has been estimated that agriculture requires 16.5 liters of water approximately of pr flood irrigation for irrigating about 10 square meters of land area in a single day. From this research study, it can also be concluded that there are various issues that are being related to the Smart Irrigation System. These issues include utilization of the battery for storing the charges and due to this there is loss of energy while battery charging forms the panels. This is followed by the discharge of battery due to supplying to the pumps which is also needed to be considered. In the areas which are slightly moist, the interval of irrigation is like four to five days. Also, there are numerous types of soil which includes clay, loam, sandy loam, clay loam, and sandy soil, determines the categories of crops as well as changes the system of irrigation which also determines the requirement of crops.

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