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Solar Powered Smart Agriculture System

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Abstract- With technological advances in almost every field, there is a growing demand for technological advances in agriculture sector too. Techniques such as automation, AI, IOT etc are being tested and used in agriculture for smart farming purpose. The modern techniques make it very reliable to collect data, store data and predict outcome. All these advances help in boosting the yield. This system helps farmer to monitor almost every aspect of the farm even if not physically present on the farm. The farmer can even control the motor from faraway workplace. The main intention of this system is to make farming easier, increase outcome and give sufficient time to farmer to learn new skills.

Keywords- Internet of Things (IOT); Sensor Technology; Automation; Actuator; Agriculture.

I. INTRODUCTION

1.1 Overview

From ages farming has been a most important occupation for human mankind. Almost 18% of Indian Gross Domestic Product (GDP) is contributed by agriculture sector. Agriculture and its corresponding industries are responsible for almost 50% of Indian employment. So, if agriculture develops, it leads to growth in many industries and Internet of Things (IOT) will play an important role for its growth and feasibility. Agriculture Policy 2020 presented new objectives; the primary goals of this policy are minimizing the utilization of synthetic manure in farming and furthermore picking up vitality efficiency. This can be tackling by IOT. IOT can tackle the changing climate issues faced by the farmer. It can reduce human interference in the farming. It can give ample of free time to a farmer for other chores. It can increase the farm yield exponentially which leads to the farmers development and thus the, thus the state and ultimately the nation. Also, it will
reduce labour cost, will use water efficiently, and will act according to the climate around the farm.

In this paper the authors have given emphasize to the data. The data provided by the controller decides the future action the farmer will take. Analysis of the collected data has been done by the author to find out interrelationship between work, yield and environment for conventional model construction. Information from rain sensor and DHT11 helps to monitor live weather around the farm. MQ2 sensor helps to monitor methane near the farm that can harm the crops by initiating the chlorosis process. Water level sensor gives the tank status and moisture sensor gives the soil moisture status. Also, the whole system is solar powered so is eco-friendly too.

1.2 Agriculture and need of technology:

Agriculture is important aspect in generation of revenue as well as source of food for many people all over the world. Over last few years this sector has seen a lot of changes and advancements in farming techniques. Various machinery, tractors, new methodologies are being developed throughout the years. All this mainly aims for improving farming output and reducing cost. Output product and time are important aspects in agriculture. The use of technology is therefore important in modern days. It ensures the growth of production within less time and also monitors the growth. Modern agriculture is advancing by continuous development in digital tools. The future is focused on efficiency that's why technologies such as Internet of things came into picture.

1.3 Internet of Things:

The Internet of things is a system where machines, objects, devices, are connected to each other by means of internet. IoT consists of internet and things in which the term things refer to various IoT devices which can perform sensing, actuating aswell as monitoring of system. IoT devices are capable of delivering live exchange of data with other devices and applications which makes this technology very important in modern agriculture. Collected data can be monitored, processed and sent to various servers.
IoT device consist different component as input output interface for sensors, interface for internet connection, memory and storage.

II. RELATED WORK

Research is carried out under the following Constraints, such as Understanding the existing approaches and methodology, Understanding the requirements, developing a better system. In [1] The proposed model (Smart Digi-farming) aims at providing smart solutions to the farming community. The farmer needs to here and there for all the different and integral work of farming. This model emphasizes the use of technology for efficient and feasible solutions. Several important works which they can easily and remotely manage. The process of farming which is mainly divided into three parts: 1. Sowing seeds 2. Maintaining crops 3. Crop ready for Digi-farming. The main focus of the model is on the crops and it's monitoring using IOT sensors and cameras. The main objective of the model is limited to Crops only. In [2] this paper, they have proposed a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology. They had used two modules, namely a smart farm sensing system and movable smart Irrigator that moves on mechanical bridge slider arrangement. Both the systems consist of microcontrollers, sensors, and the GSM module to communicate with each other and with the external environment. The smart farm sensing system senses the moisture content with the aid of the soil Moisture sensor. The measured data from the smart farm sensing system are sent to the smart irrigator via the GSM module. The farmer can have control over the system by having a wireless communication with a gsm module through his mobile phone. Smart irrigator is mounted on an overhead crane system and it consists of two main sensors that are connected to different pins of the microcontroller. It receives the signal from the smart farm sensing system via the GSM module. The recorded readings are then transferred to a central database server from which all the crop-growth details are analysed and transferred to the irrigator system. In the meantime, sensors trigger the optocouplers that are connected to green manure, seeds, compost, and water containers. After the triggering action, the necessary components are splashed on the field. As Solar panels and GSM modules are used, Solar panels will be unable to sustain so many motors, as a result more panels will be controlling the soil moisture by monitoring the level of water in the water source. The farm would be regularly irrigated automatically at particular time intervals. The motor will be turned ON and OFF by the microcontroller as the soil moisture sensor indicates availability of moisture in the soil.

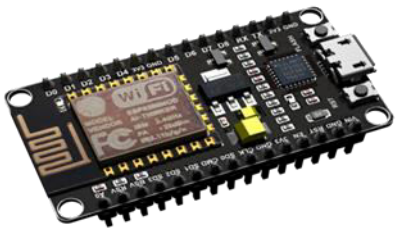
III. SYSTEM OVERVIEW

The main idea is to make agriculture smarter enough to reduce human intervention. Sensors will gather the data and controller will process and send it to the smartphone. Farmer can analyse the data and perform further task. Farmer can analyse current temperature, Humidity, water level in tank, moisture content, Methane presence, battery levels, Pump status etc. Farmer can actuate motor using smartphone.

IV. METHODOLOGY

This system focusses on fully automated farming system. A plethora of sensors are used to gather Realtime data of various parameters. This data is then processed by the controller and sent to the cloud. An android app will access this data and thus the farmer can make decisions based on this. Farmer can analyse this live data from the sensors and can actuate the motor when needed. This system can also detect harmful gases to take measures and also battery percentage to use solar panel for charging. Also, water level is detected in order to refill the tank or to know the live status of water present to avoid wear and tear of motor.

4.1 NodeMCU



NodeMCU is an open-source software hardware development environment built around a chip called ESP8266. With operating voltage of 3.3V it contains 16 I/O digital pins, 1 analog pin and networking Wi-Fi. It is a programmable, Wi-Fi enabled board with low cost and low energy consumptions.

4.2 Solar Panel

A solar panel is grid like arranged group of photo-voltaic cells mounted in a frame for installation. Solar panels use sunlight as a source of energy and generate direct current electricity. An array of a photovoltaic system supplies solar electricity to electrical equipment. Photovoltaic cells absorb light energy or photons from the sun to generate electricity through photovoltaic effect. And these cells are made of silicon semiconductors. When sunlight hits the cells, the electrons are separated from their atoms and flow through the cells which results in generating electricity. Solar panel module connected in series electrically to achieve a desired output voltage or connected in parallel to provide a desired current capability. The generated output is in DC current and stored in batteries.

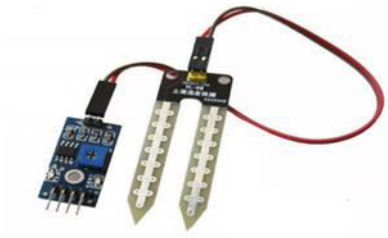
4.3 Batteries

A battery is a power source consisting of one or more electrochemical cells with external connections for powering electrical devices. Battery has two terminal named as positive terminal (cathode) and negative terminal (anode). When battery is connected to external electric circuit, a redox reaction takes place which cause flow of electrons from anode to cathode through external circuit and free energy efficiency is delivered to circuit.

4.4 Rain Sensor

Rain sensor having sensing pad with copper traces mounted on it, together acts as a variable resistor like potentiometer whose resistance varies according to the amount of water on its surface.

4.5 Soil Moisture Sensor



Soil moisture sensors measure the water content in soil, and can be used to estimate the amount of stored water in a profile, or how much irrigation is required to reach a desired amount of saturation. These sensors can be portable and used for instant measurements or installed for long-term monitoring.

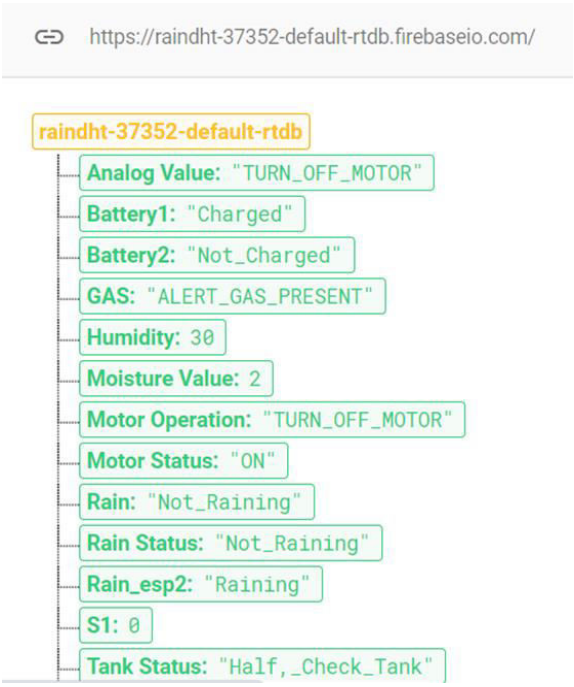
4.6 Water Level Sensor

Water Level Sensor indicates the high or low level of water in overhead tank or any other water storage containers. This sensor tells the control panel that what corrective action is needed. A combination of high and low sensing probes is immersed in tank in such a way that they can sense the level of water and sends data to controller.

4.7 MQ2 Gas Sensor:

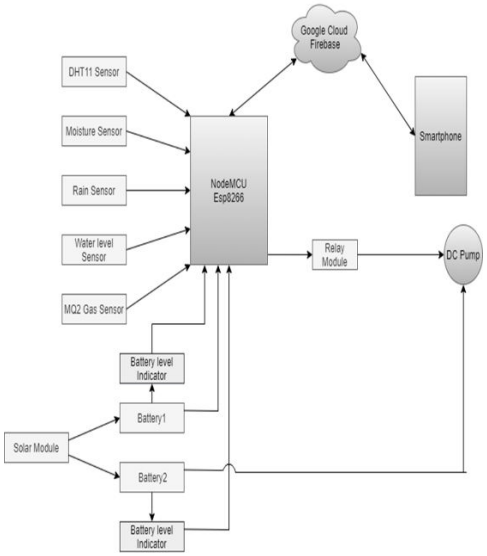
MQ2 is a Metal Oxide Semiconductor (MOS)type gas sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the gas comes in contact with material. MQ2 gas sensor can detect LPG, Smoke, alcohol, Propane, Hydrogen, Methane and carbon monoxide.

4.8 Software

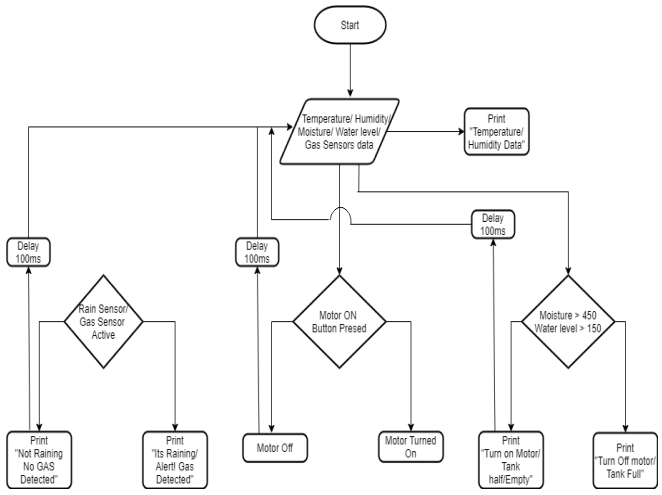


In order to store the data from the sensor along with the controller we used Google firebase as cloud service. By this we can publish any data to it and can subscribe anytime to retrieve it. It shows the Realtime database in order to analyse and act upon it.We can use this service to actuate the actuators connected to the controller.This cloud service enables the use of any 3rd party android application to access its data.The image displayed on the screen is the actual Realtime data procured from the controller.

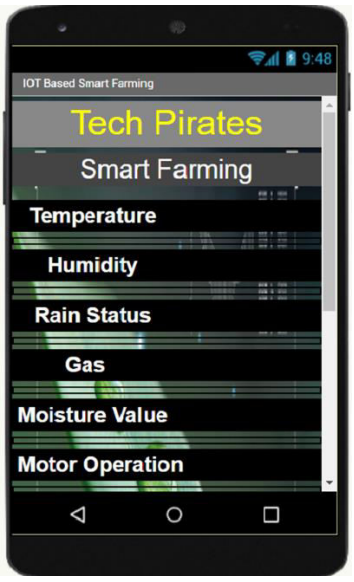
4.9 SYSTEM ARCHITECTURE



4.10 SYSTEM FLOW



V. RESULTS AND FUTURE SCOPE



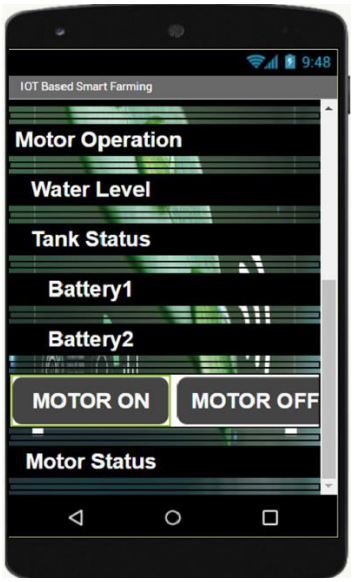
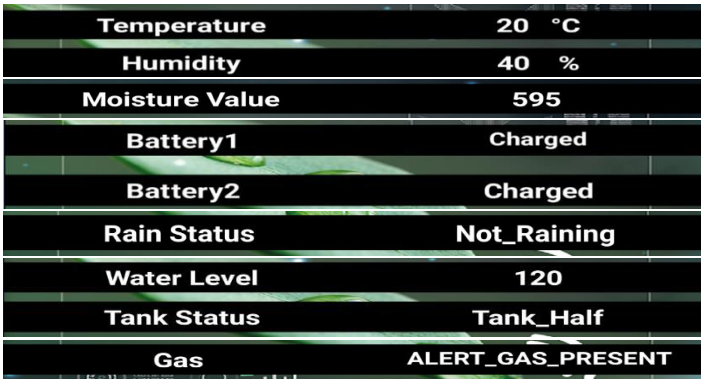


Fig:- App User Interface



6.1 Future scope for development:

1) Tools such as Artificial intelligence and Machine learning can be used to predict environmental factors. It can also detect diseases on crop.
2) Data science can be used for better visualization of the data for better understanding.
3) Ethical hacking can be used to protect the farm data.
4) Industrial IoT can be used to make this system work on a large scale and large areas.

VII. CONCLUSION

Solar powered IoT based agricultural system has been proposed using NodeMCU and Google Firebase platform. This agricultural application is making it possible for farmers and ranchers to collect meaningful data with high efficiency as well as high accuracy. With the population growing rapidly, the demand can be successfully met if the ranchers as well as farmers implement agricultural IoT solutions in prosperous manner. This system will assist farmers in increasing agricultural production and take care of it as farmers will get live accurate feed.

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