Piezoelectric Power Generation and Smart Irrigation System Using Internet of Things

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Being an agrarian country, Agriculture is the most important occupation for most of Indian families and plays a vital role in the development of our country. Water is the most critical resource for Agriculture, as 90 percent of India's groundwater is being used solely in the agriculture sector. Irrigation is method to supply water but in many cases there will be lot of water wastage also there is wastage of electricity. So, in this regard to save water, Electricity and time we have proposed project titled Footstep power generation and automatic irrigation system using IoT. The Internet of Things (IoT) is transforming the agriculture industry and enabling farmers to tackle with enormous challenges they face. The innovative IoT applications address the issues in agriculture and increase the quality, quantity, sustainability and cost-effectiveness of agricultural production as well as the reduction in resources. In this proposed system we are using sensors like soil moisture sensors which senses the various parameters of the soil and based on soil moisture value land gets automatically irrigated by ON/OFF of the motor. These sensed parameters and motor status will be displayed on user android application also Motor can be controlled from anywhere in the world.

Keywords: Internet of things (IoT), Arduino, Soil moisture sensor, Humidity sensor, Piezo-electric power Generation

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1 Introduction

In India, Agriculture provides employment to almost 50% of its population, contributes almost 18% to its GDP and 10% of total exports [1]. Water is the vital input to the agriculture in almost all its aspects including animal husbandry and Fisheries. India only has almost 4% of the total world's fresh water resources which fulfills the needs of approximately 17% of the world's population residing in the country [2]. OECD environmental outlook 2050 predicts that India would face severe water constrains by 2050. With 65% of Indian irrigation is dependent on groundwater only, India withdraws 688 billion cubic meters [3]. The need of hour is to use this depleting resource judiciously. The path to sustainable agriculture and to efficient use of water leads to the technological involvement. With the usage of sensors, devices, machines, and information technology the modern agricultural practices have been revolutionized in the past couple of years.

Internet of Things is a basically a system in which computing devices –having any processor, various sensors, devices and appliances etc are inter-connected over a network and are able to do the data transfer. The Internet of Things (IoT) is interconnecting communicating objects or devices that are installed at different locations that are possibly distant from any remote site or anywhere from the world [4]. Internet of Things (IoT) is a type of network technology, which senses the information from different sensors and makes anything to join the Internet to exchange information and also these embedded devices are capable of controlling without interference of human. IoT is being used extensively in many consumer applications such as smart home, home automation, in medical and health care etc. The IoT is changing the future of farming with the technological innovation. IoT is changing the agriculture domain and empowering farmers to fight with the huge difficulties they face. The agriculture must overcome expanding water deficiencies, restricted availability of lands, less electricity then required amount while meeting the expanding consumption needs of a world population. Emerging new innovative IoT applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. With IoT, farmers can use sensors to collect data on acidity and temperature of the soil, rainfall, humidity, wind speed etc, to remotely monitor their equipment, crops, and livestock and many other applications.

In this project, soil moisture using sensor is measured and based on soil moisture value land gets automatically turn on or off. The main advantage of using IoT & soil moisture sensor is that it will turn on the water pump only when it is required by sensing the moisture level of the soil resulting in saving the water wastage. As the water pump is also linked with mobile app, the farmer doesn't need to go to fields to turn On/Off the water pump every time. Also rather than using traditional electricity the project make use of peizo-electric generator which convert pressure from recurring footsteps into electricity.

2 Literature Survey

Recent research work accomplished by various researchers for power generation and programmed irrigation system is as follows:

For proper utilization of water in agriculture, **Sahaya Sakila et al.** [5] realized automatic irrigation system based on the value of soil moisture, temperature and humidity. This system was mechanized with the control unit to regulate the level of water. **S. Vaishali et al.** [6] developed a mobile integrated smart irrigation system by examining the moistness of the ground. This system controlled the level of water by smartphone. **J. Karpagam et al.** [7] implemented a microcontroller system to moisten the plants. The need of water was determined by the sensors and developed system. Then the information was provided to the farmers. **Saranya G et al.** [8] produced the power by the movement of human when walking on the piezoelectric sensor and produced the kinetic energy that was transformed into electrical energy. This energy then was utilized for various applications like mobile charging and irrigation purpose etc. Furthermore, all the information is stored using IoT for constantly monitoring.

3 System Model

The project model is composed of piezoelectric power generation section, soil sensor, ESP-32 module,

mobile app to control the water pump. The block diagram of the proposed work is shown in Fig. 1.

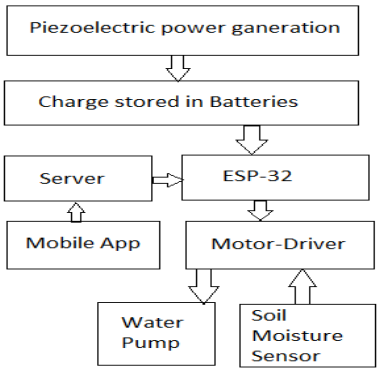

Fig. 1: Block Diagram of proposed work

3.1 Piezoelectric power generation is an approach to generate electrical energy from pressure and vibrations. The material used for this purpose is called piezoelectric material. Quartz crystal is excellent example of piezoelectric material.

3.2 ESP32 Module is a microcontroller series of low cost, low power system on a chip. ESP-32 is a dual-core processor that runs at 160MHz to 240MHz.

3.3 Arduino IDE is open-source software, it can be used to create codes and upload it to any controller

3.4 **MIT App Inventor** is an educational tool to learn computational thinking and computational action principles through building mobile apps. It is mostly used to test drive projects, debug blocks code & design and code personal projects.

4 Working of Project

When we step on the disk which is made up of piezoelectric material, it will produce some amount of energy in form of electricity. Amount of generated energy depends on amount of pressure in disk. The number of disks is connected in parallel to cover most of area and also produce more power. Piezoelectric power generation parameters are given below in the Table 1:

Table 1: Weight vs Power

Weight (kg)	Power (mA) generated
1	1.12
2	2.2
4	3.9
7	4.5
10	5.1

The generated power is then stored in battery. For the controlling purpose in the project ESP8266 microcontroller is used and it is programmed under Arduino IDE. ESP8266 offers inbuilt Wi-Fi and also

high resolution ADC. Controlling of pump is managed via server and also soil moisture sensor is continuously monitored.
Pump can be turn on and off by an android app which is made using MIT app inventor. Here data is push button are send to Google firebase which serves as intermediate connection between ESP8266 and Android mobile app. Firebase data will changed after pressing button in android app. On the other side ESP8266 regularly monitor data in the firebase and work according to this data.

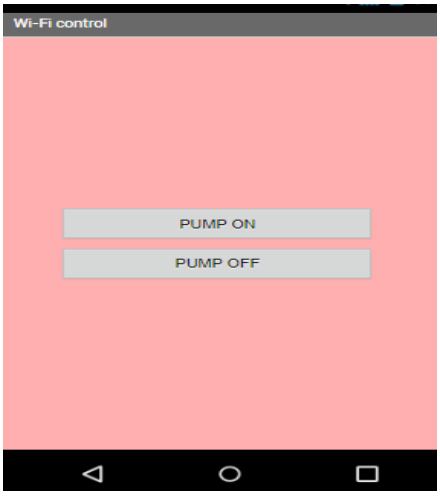

Fig. 2: Smart-phone application

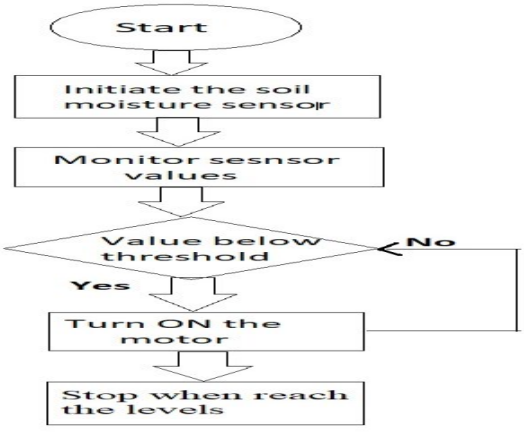

Fig. 3: Flow chart of proposed system

When water goes up to specified limit soil moisture sensor send signal to ESP8266 which then turn off motor. The limit of water can be adjusted from potentiometer of soil moisture sensor.

5 Future Scope

In the Future, this system can be made as an intelligent system where there is not only single sensor but a cluster of sensors. where in the system predicts user actions, pH measuring sensor, rainfall pattern, time to harvest, draught investigation, animal intruder in the field and communicating the information through advanced technology like IoMT and IoF can be implemented so that agricultural system can be made independent of human operation as low as possible and in turn quality and huge quantity yield can be obtained.

6 Conclusion

The application of agriculture networking technology is need of the present modern agricultural development, but also an important symbol of the future level of agricultural development as well as technical development; it will be the future direction of agricultural development. After building the agricultural water irrigation and piezoelectric power generation system hardware, Software and analyzing and researching the network hierarchy features, functionality and the corresponding software architecture of precision agriculture water irrigation systems and power generation actually applying the internet of things (IoT) to the highly effective and safest agricultural production has a significant impact on ensuring the efficient use of water resources as well as ensuring the efficiency and stability of the agricultural production and also development of renewable power generation methods. With more advancement in the field of IoT expected in the next coming years, these systems can be more efficient, much faster, less costlier and available to everyone.

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