EMPOWERING FARMERS FOR A PROSPEROUS INDIA: IOT ENABLED AUTOMATIC IRRIGATION AND PREVENTION OF ANIMAL INTRUSION FOR BETTER CROP YIELD

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ABSTRACT. Agriculture is one of the major sources of livelihood in India. It's roughly estimated that about 58 percentage of the Indian population are still farmers. It's the main stay of our country's economic growth. Farming by itself requires a lot of manual effort and resources. The major problems in farming are damage to crops and human lives by animal intrusion and improper irrigation of the farmlands. The main aim of this project is to provide protection for the crop by detecting animal intrusion using Ultrasonic sensor and constantly monitoring the weather conditions for the farmers using Soil Moisture sensor and Rain sensor. In addition the project also includes automatic irrigation system which helps to switch 'ON' and switch 'OFF' the water motor automatically based on the moisture level of the soil and the climatic condition using IOT. The automatic irrigation system automatically waters plants when moisture level of the required plant is low. The motivation for developing this application is to reduce manual effort, to provide high security and improve yield by better irrigation.

1. INTRODUCTION

The Indian Agriculture dates back to Indus Valley Civilization. India is the world's second largest producer of food crops. As per reports of 2019, agriculture engages more than 50 percentage of the Indian work force and contributes

17-18 percentage to country's GDP. It plays a vital role in the growth of country's economy. One of major problems faced by our farmers is loss of human lives and crops due to wild animal intrusion. Second major issue is only a third of the farming land in India is under irrigation, the rest depending on tropical monsoon. Only adequate rainfall means a good crop year. Hence the need for our Prime Minister's "Pradhan Mantri Krishi Sinchai Yojana" and the need for citizens to use technology towards the same. In this regard agriculture can be made smart and intelligent using Internet of Things (IoT). IoT is an excellent technology that eases human effort and helps in accessing distantly placed physical devices. This technique has an autonomous control feature that controls all devices without any human intervention. The project aims at using IoT to a) Monitor animal intrusion using Ultrasonic sensor - thus providing protection for the crop b) Monitor the moisture level in the soil using Soil Moisture Sensor c) Supervise the weather conditions using Rain sensor c) Automatically irrigate the field by switching 'ON' and 'OFF' the water motor based on the moisture level of the soil. When rain is detected this system switches 'OFF'.

2. LITERATURE SURVEY

AJAYI OO and OLAIFA O proposed the system [1], a deterring and a monitoring system to prevent potential damages in agriculture, from wild animal attacks on large farm areas. This system uses virtual fence constructed using motion sensor based on IoT to detect intrusion. To prevent crop damage by elephants, the tribals in the area developed an indigenous technique called slippery beds. Slippery beds were prepared using tall grasses. The cut and dried tall grasses were placed along the slopes of the banks throughout its length without any gap; this made it a very slippery stretch. If anything stepped on the grass, it would make the animal stumble or slip. To prevent crop damage by elephants, the tribals in the area developed an indigenous technique called slippery beds. Slippery beds were prepared using tall grasses. The cut and dried tall grasses were placed along the slopes of the banks throughout its length without any gap; this made it a very slippery stretch. If anything stepped on the grass, it would make the animal stumble or slip. To prevent crop damage by elephants, the tribals in the area developed an indigenous technique called slippery beds. Slippery beds were prepared using tall grasses. The cut and dried tall grasses

were placed along the slopes of the banks throughout its length without any gap; this made it a very slippery stretch. If anything stepped on the grass, it would make the animal stumble or slip. [2] - This system generates an alarm to the farmer's house and also transmits a text message to the farmer's cell phone simultaneously when an intruder enters into the field. This is implemented using Advanced Virtual RISC (AVR) micro-controller-based wireless sensors. Santhoshi K. Jai and S. Bhavana proposed a system [3], "Intruder recognition in a farm through wireless sensor network"- In system multiple motion sensors are placed at different locations in the farm. These sensors captured the movement and communicate through Radio-frequency transceiver. This in return raises a warning alert and a call is placed to the farmer mobile through GSM. To differentiate between authorized and unauthorized entries radio-frequency identification tags are implemented. Shanmukhappa Angadi and Raghavendra Katagall proposed a system [4]- This system employs Raspberry Pi to detect any intrusion in the farm which triggers the PiCam to take pictures. These images are then identified by an image processing module having shot detectors and Mobile nets technique of Deep Learning using OpenCv. This information is transmitted to the farmer as notification in email and telegram tool. N S Gogul Dev,K S Sreenesh,P KBinu, proposed the system [7] - This system will provide a complete technical solution using the Internet of things (IOT) to the farmers to protect their crops from wild animals and provide information to the farmers to maximize their production. Animals are detected using PIR sensors and cameras where animals are identified using Tensor Flow image processing Techniques. Raspberry PI is used as the processing unit of the system and sound buzzers are used to emit the ultrasound frequencies. R. Nageswara Rao and B. Sridhar, proposed the system [10] - "IoT based smart crop-field monitoring and automation irrigation system "-A Raspberry Pi based automatic irrigation IOT system was used, to develop crop at low quantity water consumption. The focus is on water availability to the plants at the required time. The proposed system developed on the information sent from two sensors (PIR sensor and camera) and estimate the quantity of water needed.

3. ARCHITECTURE DIAGRAM

IN figure1, the main idea of this system is to detect wild animal intrusion into the farm from the forest using ultra sonic sensors placed at multiple locations
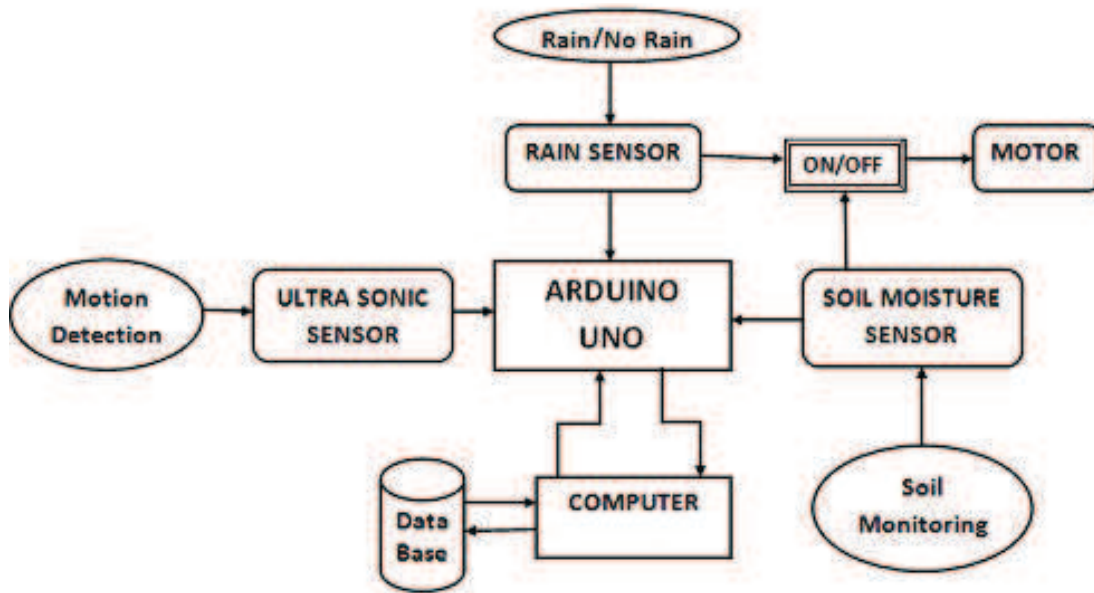
FIGURE 1. Architecture Diagram.

in and around the farm covering a wide area. When an intruder is detected / sensed the buzzer is turned 'ON' which alerts the residence of the farm. Another wing of this project is continuous monitoring of the moisture content of the soil and the weather condition. In addition, the project also includes automatic irrigation system which helps to switch 'ON' and switch 'OFF' the water motor automatically based on the moisture level of the soil and rain in the area using IOT. The motivation for developing this application is to reduce manual effort, to provide high security and to improve crop yield. Primary goal is to connect the entire sensor (soil moisture sensor, rain sensor and ultra sonic sensor) and monitor the weather and moisture level in soil. If the moisture level is low the sensor which is connected to the motor pump automatically turns on and cuts off when the humidity is back to normal. All these details of the pump turning off and on are stored in the database and can be viewed later. If an animal enters the farm the ultra sonic sensor detects the motion in the farm and intimates the people in the farm with a buzzer.

3.1. **Detection of Intrusion.** Intrusion of wild animals and unwanted elements are detected using HC-SR04 Ultrasonic sensor. These sensors have two main components: the transmitter and the receiver. They emit ultrasonic sound waves

FIGURE 2. Ultrasonic sensor and its working.

TABLE 1. MOTOR IS SWITCHED ON/OFF

RAIN	SOIL MOISTURE	MOTOR [ON / OFF]
NO	LOW [DRY]	ON
NO	HIGH [WET]	OFF
YES	LOW [DRY]	OFF
YES	HIGH [WET]	OFF

at 40 kHz frequency, which helps in measuring the distance of a target object and converts the reflected sound into an electrical signal. This electric impulse is connected to a buzzer which goes ON, when an intrusion is detected. Ultrasonic Sound is sent and received when the motion is detected

3.2. **Motor pump Testing.** In this module, soil moisture sensor senses the moisture level of the soil. If soil will get dry (water level is low), module output a high level, which automatically switches on the water pump to supply water to the plant. As plant gets watered, soil becomes moist. Then sensor senses enough moisture level in the soil and the water pump will be automatically stopped [Fig 5]. When it starts to rain in the area [9], it is sensed by the Rain sensors which will automatically switch off the motor (if it's in the on mode else nothing happens). To perform this use two components 1. Soil Moisture Sensor is used to measure the water content of soil. 2. Rain Sensor is activated when rain occurs in the region. Based on 4 conditions represented in table the motor is switched ON/OFF.

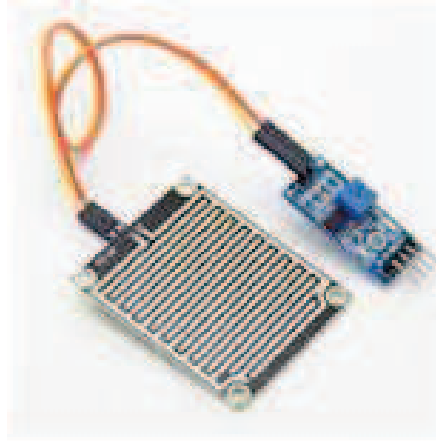The temperature, humidity and moisture level of soil differs based on crops and types of soil.

FIGURE 3. Rain Sensor /Rain Switch.

FIGURE 4. Soil Moisture Sensor.

4. RESULT AND DISCUSSION

The experimental results of for Empowering Farmers for a Prosperous India: IoT enabled automatic irrigation and prevention of animal intrusion for better crop yield, was obtained after implementing the above discussed system. This project was simulated in various scenarios to reveal the workability of the proposed system. The results and various outputs were recorded in our database. Fig 6 illustrates when the motor is switched ON-OFF based on Sprinkling water on Rain sensor and Soil moisture content detected. The Rain sensor output is in volts, when the board is dry; it exhibits 5volts and as the board becomes wet its voltage starts to reduce and finally turns zero volts (that's when the motor turns OFF).
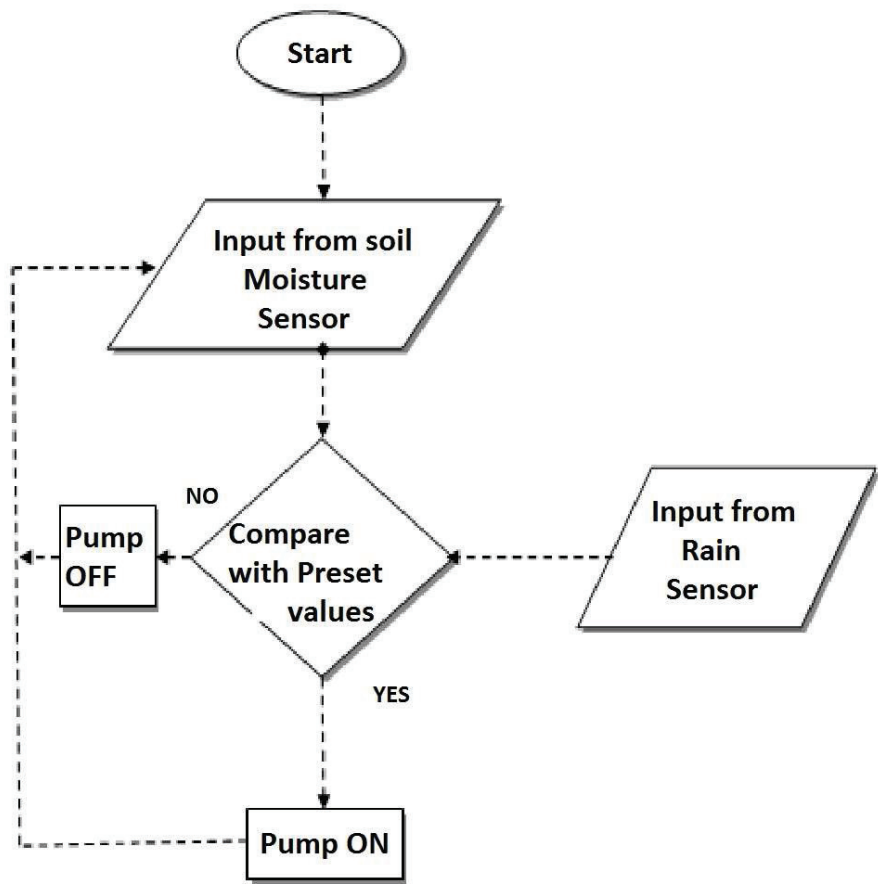
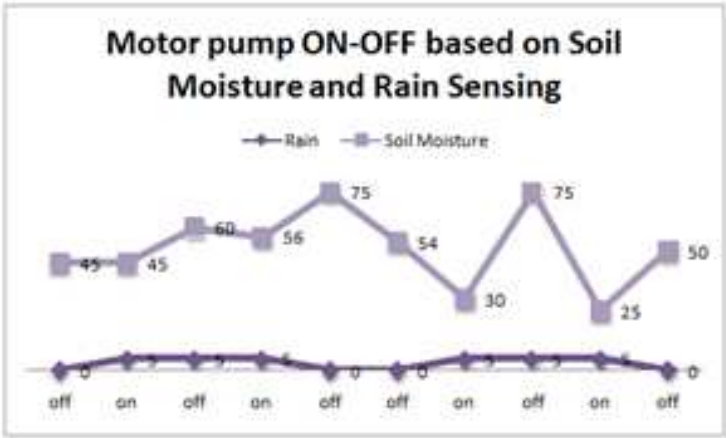FIGURE 5. Flow chart for Motor pump Testing.

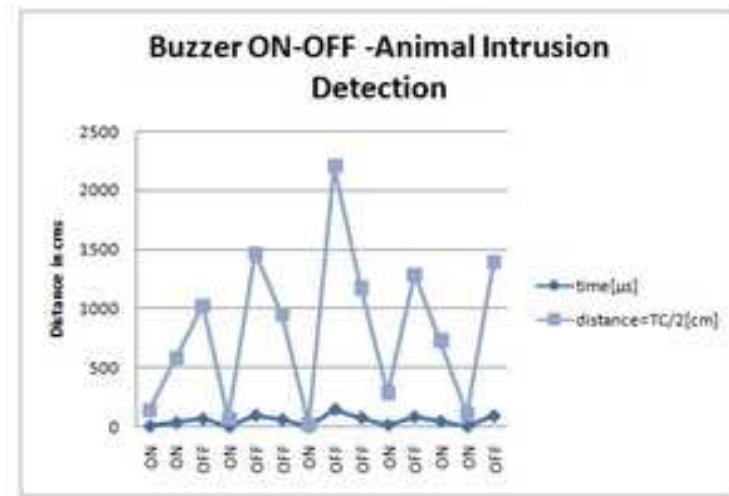FIGURE 6. Soil Moisture and Rain Sensing against Motor ON-OFF.

FIGURE 7. Time and Distance against Buzzer alert.

The results were obtained by placing obstacles in the experimental setup for animal intrusion detection module using ultrasonic sensors. For an obstacle placed at a particular distance from the sensor, then the distance is calculated by

Distance= $1/2 * T * C$

[T-Time taken and C- speed of sound is 340m/s]

As the object moves closer to sensor [distance < 10m or 1000 cm] the buzzer is turned ON [Fig 7], which alerts the farmers.

5. CONCLUSION AND FUTURE WORK

Empowering Farmers for a Prosperous India: IoT enabled automatic irrigation and prevention of animal intrusion for better crop yield, shows that the system will reduce manual labour of farmers by continuous monitoring of intrusion of wild life and constant checking of humidity and moisture level in the soil. Thus automating the water pump for irrigation and sending alerts before animals intrude the farm area. As future work, Image recognition of animals and mobile message alerts can be included. The authors declare that there is no conflict of interest.

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