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Development of IoT Based Monitoring System in Smart Agriculture

Jinnat Saba[1], *Shams Tanveer* [1]*, *Soumyata Singh*[1], Sanghamitra Layek[1], Bikas Mondal[2]

[1]Department of Electronics and Instrumentation Engineering, Narula Institute of Technology, Agarpara-700109, India

[2]Department of Electronics & Computer Science, Narula Institute of Technology, Agarpara - 700109, India

Correspondence*: tk23092012@gmail.com

Abstract:

Application of sensors in food and agriculture sectors improves environmental sustainability and a bright future in addition to feeding the world's population. This emerged as a transformative way, revolutionizing traditional practices and paving the way for greater efficiency, sustainability, and food safety. This abstract provides a concise overview of the multiuse applications of sensors in the agriculture sector. Sensors play a pivotal role in precision farming. Soil sensors enable real-time monitoring of moisture levels, humidity, nutrient content, and temperature, facilitating optimized irrigation and fertilization. Weather sensors provide accurate meteorological data, assisting farmers in making informed decisions regarding planting, harvesting, and resource allocation. Temperature and humidity sensors ensure the integrity of perishable goods during transportation and storage, reducing food waste. PH sensors provides the acidic or basic nature of the soil. Internet of Things (IoT) has enabled the creation of interconnected sensor networks which helps the farmer by providing the accurate data of the field which is beneficial as well as makes them understand the condition of filed in a better way and also reduces some work load. In conclusion, sensor applications in the food and agriculture industry are pivotal in addressing the growing global challenges of food security, resource management, and environmental sustainability. As technology continues to advance, the integration of sensors and data-driven solutions promises to revolutionize these industries, ensuring a more resilient and sustainable future for agriculture and food production.

Index Term: *Temperature sensor, Humidity and Moisture Sensor, PH sensor, IoT, Stability Revolution.*

Introduction:

A sensor is a device or component that notices physical changes or environmental conditions and reacts to them. These changes are transformed into electrical or digital signals that can be analyzed, displayed, or applied in a variety of ways. Sensors can be used to measure a variety of variables, including temperature, pressure, light, humidity, motion, and many others. In order to increase production efficiency, product quality, and sustainability, Different sensors can be used in the food and agriculture sector. The authors offer real-time data and monitoring capabilities. By the help of these sensors, we can access food quality monitoring, food traceability, Pesticide and Chemical residue detection, Nutritional analysis, Precision agriculture, Reducing the food waste, Allergen detection, Water quality monitoring, Livestock health monitoring and Supply chain transparency, thus ensuring that consumers have access to healthier food options [1]-[3]. The application of sensors in the food and agriculture industry can help prevent non- communicable diseases (NCDs) by improving food safety, quality, and traceability, thus ensuring that consumers have access to healthier food options [4]-[5]. Here is how sensors can contribute to NCD prevention in these industries:

1. Food Quality Monitoring:

Temperature and Humidity Sensors: These sensors can keep an eye on the conditions of perishable food storage and transit to make sure they are kept at the proper temperatures to avoid contamination and deterioration.

2. Food Traceability:

RFID (Radio-Frequency Identification) and QR Code Scanners: These sensors and technology can educate consumers about the source, preparation, and nutritional value of food products. This openness enables customers to make wiser, healthier decisions**.**

3. Pesticide and Chemical Residue Detection:

Chemical Sensors: These Sensors can find chemical pollutants and pesticide residues in food products, protecting customers from harmful substances. This can lower the chance of NCDs brought on by chemical exposure.

4. Nutritional Analysis:

Spectroscopy Sensors: These sensors are capable of analyzing the vitamins, minerals, and macronutrients that are present in food products. Customers can utilize this knowledge to choose a diet that is better for them.

5. Precision Agriculture:

Soil and Environmental Sensors: These sensors can keep an eye on the environment and the health of the soil, allowing farmers to maximize crop yield. They support healthy diets by making sure nutrient-rich foods are available [6].

6. Reducing Food Waste:

IoT Sensors: Food waste can be decreased with the use of these sensors that monitor food freshness and shelf life. Food waste reduction improves consumer access to nutrient-dense products and may result in lower prices [7].

7. Allergen Detection:

Allergen Sensors: For people who have food allergies, the ability of these sensors to detect allergens in food products is essential. Allergy reactions, which might be fatal, must be avoided in order to be prevented.

8. Water Quality Monitoring:

Water Sensors: Assuring the quality of the water used for food processing and irrigation helps stop contamination and the spread of waterborne infections, which indirectly aids in the reduction of NCDs [8].

9. Livestock Health Monitoring:

Animal Health Sensors: Sensors can keep an eye on the health and happiness of livestock, lowering the risk of zoonotic infections and ensuring the security of products obtained from animals.

10. Supply Chain Transparency:

Blockchain Technology:

Blockchain and sensors work together to build transparent supply chains that let customers follow their food from farm to table. This openness can encourage healthier choices and foster consumer confidence in the food supply. Sensors in the food and agriculture sector can improve food quality, safety, and transparency, thereby enhancing consumer decision-making, lowering exposure to harmful substances, and ultimately assisting in the prevention of NCDs through healthier diets and lifestyles [9].

Table-1: Sensors and their function

Sensors	Functions
Optical Sensors	Optical sensors assess crop health, monitor soil properties, detect ripeness, and identify pests and sustainable farming practices.
Electrochemical Sensors	Electrochemical sensors analyze soil and water properties, optimizing fertilizer use and enhancing crop growth through precise data.
Mechanical Soil Sensors	Mechanical soil sensors measure soil compaction, aiding farmers in soil health assessment and crop root development.
Dielectric Soil moisture sensors	Dielectric soil moisture sensors measure soil moisture content for efficient irrigation and crop health monitoring in agriculture, aiding water resource management.
Location Sensors in Agriculture	Location sensors in agriculture use GPS or GNSS for precise tracking of equipment and assets, optimizing field operations and enabling data-driven decisions.
Electronic Sensors	Electronic sensors in agriculture collect data on various parameters such as soil moisture and temperature, supporting precision farming practices.
Airflow Sensors	Agricultural airflow sensors keep an eye on ventilation in barns and livestock facilities to ensure that crops and animals are kept in good health.
Insect and Pest monitoring sensors	These sensors can detect the presence of pest and insects in fields, allowing for timely pest control measures.
Light Sensors	Light sensors measure light intensity for crop growth assessment, helping optimize planting and harvesting times in controlled environments.
Temperature Sensors	Temperature sensors monitor air and soil temperatures to guide planting and harvesting decisions.
Livestock Monitoring Sensors	Livestock monitoring sensors such as RFID tags uses for tracking and health monitoring

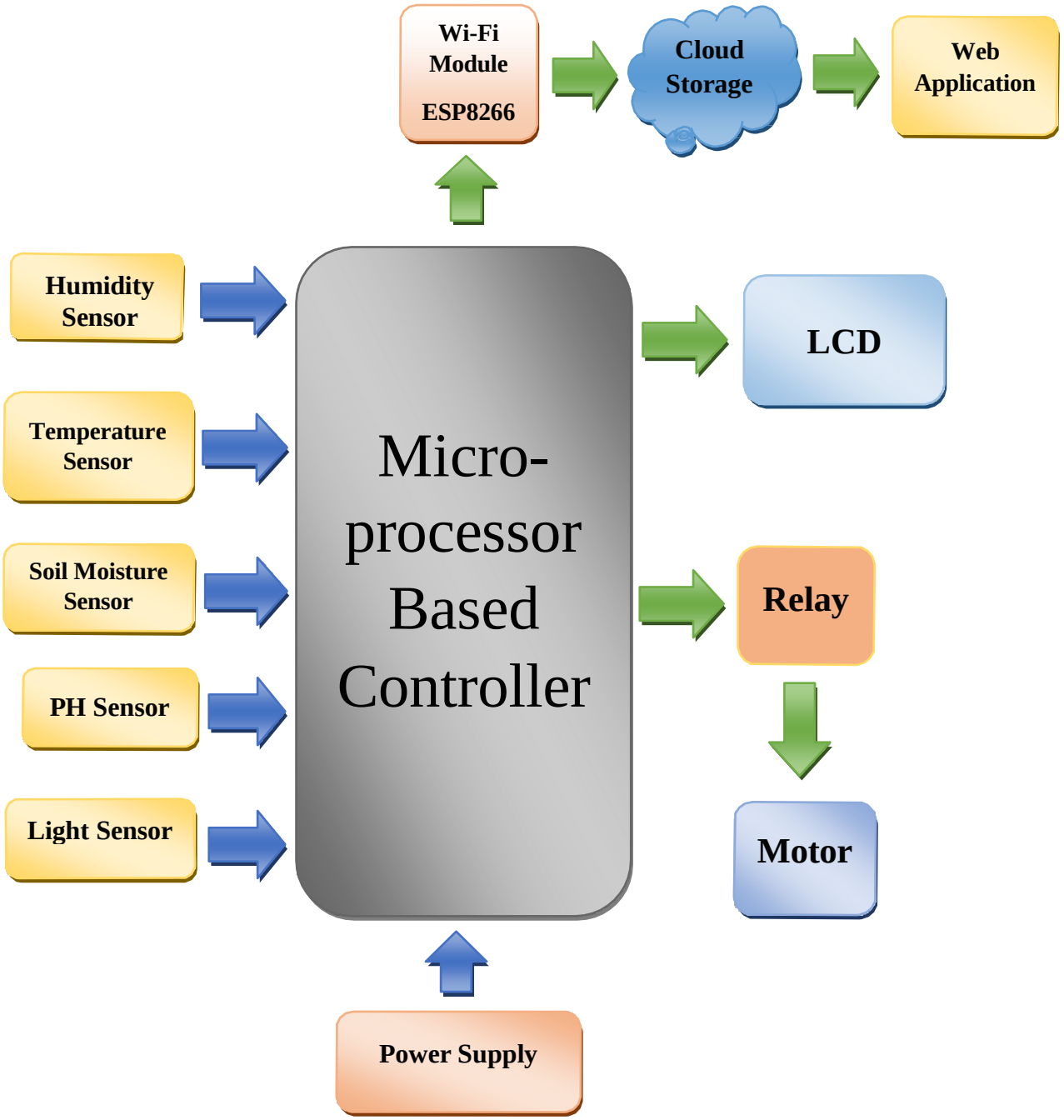


Figure 1: Block diagram of proposed of IoT Based Monitoring System in Smart Agriculture

Table-2: Sensors with their working range

Sensors	Quantity	Range
Humidity Sensor (DHT11)	1	0%RH~100%RH
Temperature SensorLM35	1	-40℃~+80℃
Soil Moisture Sensor (LM393 Module)	1	ADC value 0-1023
PH Sensor	1	0-14 (9)
Light sensor	1	430 to 610 nm.
ESP 8266	1	Less than 20meter
Relay module	1	5V

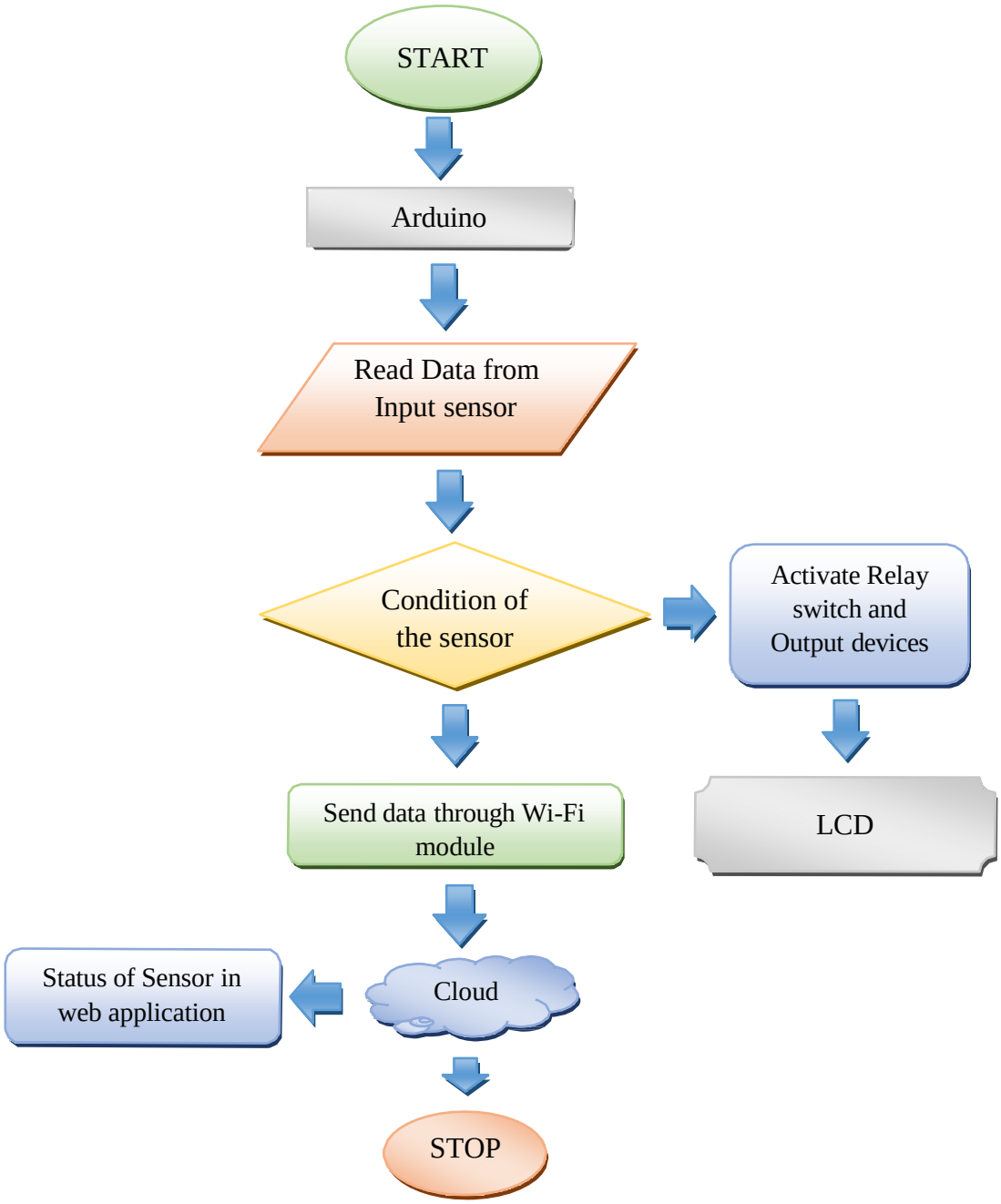


Figure 2: Flow Chart of Proposed IoT based Monitoring System in Smart Agriculture

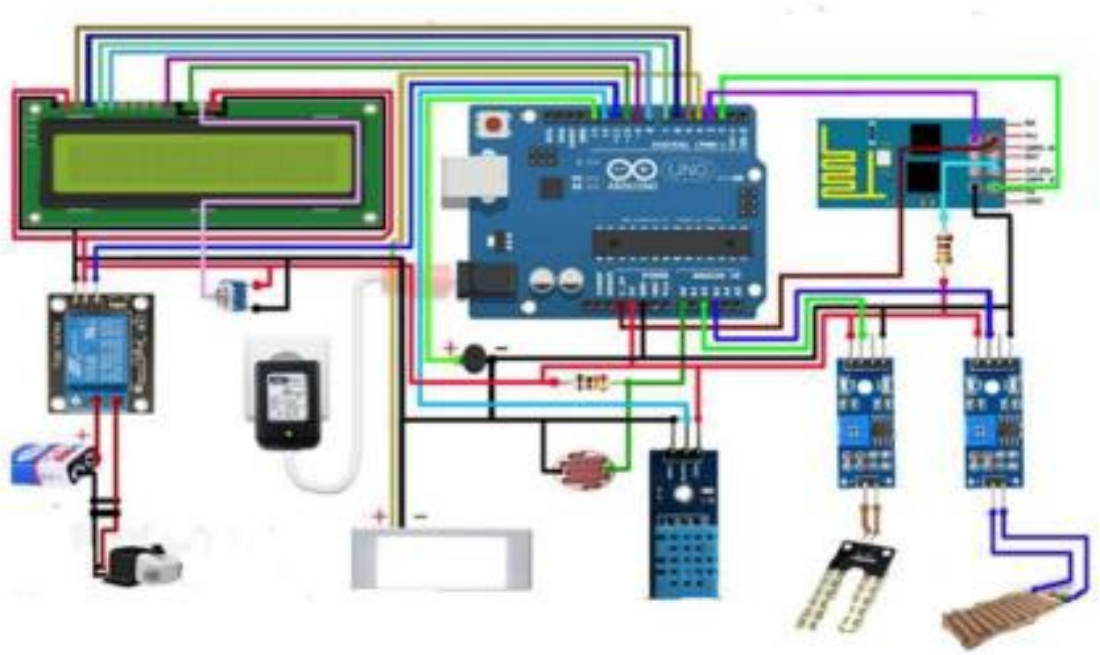
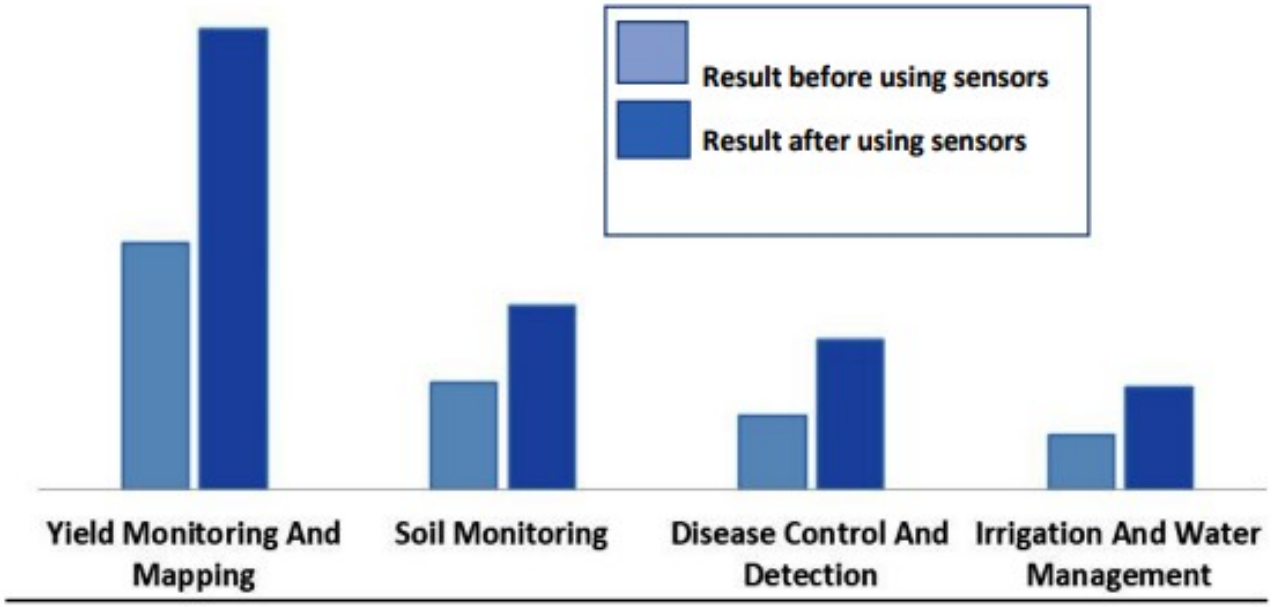


Figure 3: Circuit Diagram of Proposed System



Results:

Whenever the moisture level is less than 40% the motor will turn on and supply the water to field and if the moisture level is greater than 40% the motor will automatically turn off. At night the light sensor detects the darkness and turn on the lights at the field. Details of the crops (moisture level, temperature and humidity, rain, lights etc.) will display on LCD Board [10].

Figure 4: Graph showing result before and after using sensor

Conclusion:

As we know that agriculture plays a major role in our society. This paper mainly focusses on smart farming system. In future, while the people demand the comfort life, it is expected that this project will decrease the manual labor as it is fully automatic. Not only that but it will also providefarmers to use just the right amount of water and fertilizer. Also, we will get the best result in terms of not eating too much contaminated crops yield by farmer before of using sensor. Application of these sensors are as follows- agriculture livestock watering, crop irrigation, home gardens, for roof gardening irrigation system, soil moisture tracking, remotely tracking of the status of crops, can be used in smart greenhouse system, monitor climate conditions [11]. As well as it has many advantages which leads to energy efficient, decreases water wastage, eco-friendly, reduces manual labour, allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds and etc., cost effective method, delivers high quality crop production.

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