EcoSaviour: Implementing an integrated agricultural system

1st Samanta Binte Taher
Department of Computer Science and Engineering
Brac University
Dhaka, Bangladesh
samanta.binte.taher@g.bracu.ac.bd

2nd Md. Mahim Muntasir Arin
Department of Computer Science and Engineering
Brac University
Dhaka, Bangladesh
mahim.muntasir.arin@g.bracu.ac.bd

3rdAnatra Raida Anika
Department of Computer Science and Engineering
Brac University
Dhaka, Bangladesh
antara.raida.anika@g.bracu.ac.bd

4th Eidrafin Islam Rafin
Department of Computer Science and Engineering
Brac University
Dhaka, Bangladesh
eidrafin.islam.rafin@g.bracu.ac.bd

***Abstract*—Modern agriculture and landscaping have revolutionized plant care with innovative solutions with the help of IoT. Our system Ecosaviour combines sensors, intelligent controllers, valves, detecting harm from substances and bugs, and various irrigation methods, revolutionizing the way we water gardens, lawns, and fields.**

***Index Terms*—IoT, Agricultural automation, sensors, Arduino Uno**

I. Introduction

Automatic irrigation and welfare systems revolutionize agricultural and horticultural practices by providing precise, efficient, and automated plant hydration, addressing challenges like unpredictable weather, water scarcity, and labor-intensive maintenance. Ecosaviour relies on sensors gathering data from the environment. Any insects in the plant area will be detected by ultrasonography, and a buzzer will be used to protect the plants. Moreover, any harmful gas present in the plant area will be picked up by the gas sensor. In addition, The soil moisture sensor measures water content, providing insights into soil watering needs, eliminating guesswork and enhancing efficiency. At its core, the Arduino Uno serves as the cerebral nexus, where data from the soil moisture sensor converges to determine the hydration status of the soil. This data, processed through a programmed algorithm, forms the basis for the system's decisions. This module not only communicates with the user or central management system through cellular networks but also enables remote control and monitoring, propelling the system beyond the confines of physical presence. The LCD display and LEDs amplify user interaction and feedback, with the former visualizing critical data and the latter providing intuitive indicators for system status.

II. APPLICATION

A. Indoor Environment

The EcoSaviour finds its versatile application in a range of contexts, from residential gardens to commercial agriculture. In-home settings, it ensures the flourishing of indoor and outdoor plants by detecting and deterring pests through ultrasound sensors and alerting with buzzers, creating a serene environment.

B. Outdoor Environment

Within large-scale farms, this system becomes an essential guardian, safeguarding crops by detecting toxic gases through advanced sensors, thereby enhancing both yield and quality. The precise control of watering, facilitated by soil moisture sensors and water pumps, not only optimizes resource usage but also maximizes plant health. Ultimately, the Plant Welfare System transcends boundaries, becoming a technological cornerstone in the realms of gardening, agriculture, and environmental conservation.

III. TECHNOLOGY

A. Soil Moisture Sensor

A Soil Moisture Sensor is an electronic device designed to measure the amount of moisture present in the soil. It operates by utilizing the principle of capacitance or resistance changes in the soil caused by its moisture content.

In this system, a Soil Moisture Sensor is integrated into the soil at the root level of plants. The sensor constantly measures the soil's moisture level and provides real-time data to the system's microcontroller. This data serves as a critical input, allowing the system to assess whether the soil requires watering. If the moisture level falls below a predefined threshold, indicating that the plants are in need of hydration, the microcontroller triggers the irrigation process, ensuring that water is supplied precisely when and where it's needed, promoting optimal plant growth and conserving water resources.

The soil moisture sensor measures the moisture content of the soil around the plant's roots. It typically uses conductivity-based measurements, where higher moisture levels lead to

increased electrical conductivity. This data provides insights into whether the plant requires watering.

B. Ultrasonic Sensor

An Ultrasonic Sensor is a device that utilizes sound waves beyond the range of human hearing to measure distances and detect objects. It typically consists of a transmitter that emits ultrasonic pulses and a receiver that captures their echoes.

The ultrasound sensor within this system is employed to detect bugs nearby. When the sensor emits sound waves, they travel outwards and interact with objects in their path, including insects. The waves bounce off the insects and return to the sensor, providing information about their presence, distance, and movement patterns. By interpreting the time it takes for the echoes to return and the strength of the signals, the sensor can determine the presence of bugs and their proximity to the plants.

C. Buzzer

To protect plants from bugs, the ultrasound sensor is integrated into a system that includes a buzzer. When the sensor detects bugs in close proximity to the plants, it triggers the buzzer to emit sound waves or vibrations at frequencies that are unpleasant or disruptive to the insects. This discourages the bugs from remaining near the plants, creating a deterrent effect that helps safeguard the plants from potential damage. This non-invasive approach provides an environmentally friendly way to manage pests and protect plant health.

D. Gas Sensor

A gas sensor is a specialized device designed to detect the presence of specific gases in the environment. It operates by utilizing chemical reactions or physical processes that are sensitive to the target gas, producing an electrical signal that can be measured and interpreted. In Ecosavior, the gas sensor is calibrated to identify toxic gases that might be present near plants. When a toxic gas, such as carbon monoxide or ammonia, is present in the surrounding air, the gas sensor reacts to its presence. This reaction leads to a change in the sensor's electrical properties, generating a signal that indicates the gas's concentration.

To protect plants, the system is programmed to respond to elevated levels of toxic gases. When the gas sensor detects such gases beyond safe thresholds, it triggers an alarm to alert the user. This alarm can take the form of audible alerts, visual indicators, or notifications sent to connected devices like smartphones or computers. This timely warning empowers users to address the issue promptly, implementing necessary measures to ensure the health and well-being of the plants in their care.

E. Water Pump

The water pump is controlled based on the readings from the soil moisture sensor. When the moisture levels drop below a predefined threshold, indicating that the plant needs water, the pump is activated. It delivers an appropriate amount of water to the plant's roots, ensuring optimal hydration without overwatering.

F. Motor Driver

This L298N Motor Driver Module is a high power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control.

G. LCD Display

A 16x2 LCD (Liquid Crystal Display) is a type of alphanumeric display commonly used in electronic devices to present text and simple graphics. It consists of 16 columns and 2 rows of characters, allowing for the display of up to 32 characters at a time.

The LCD display serves as the interface for users to monitor the system's status and receive updates. It displays real-time information, such as bug detection alerts, gas concentration levels, soil moisture status, and pump activation. This information allows users to make informed decisions and take timely actions to address any issues affecting plant health.

In this integrated system, the sensors work together to create a dynamic and responsive environment for plants. The ultrasound sensor and buzzer protect plants from bugs, the gas sensor detects toxic gases, the soil moisture sensor ensures proper watering, and the LCD display provides users with essential information. This holistic approach combines technology and nature to nurture healthy and thriving plant life.

IV. CIRCUIT DIAGRAM

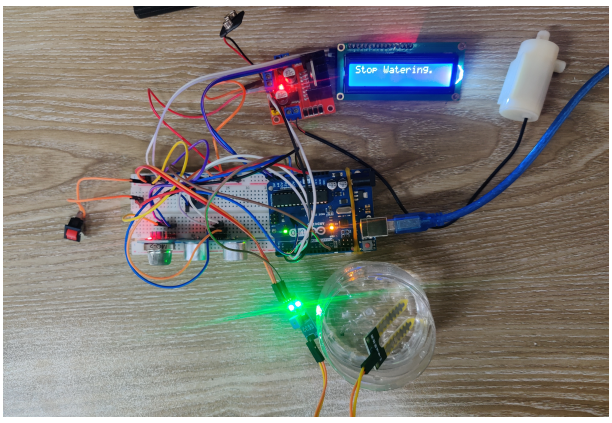

Fig. 1. circuit diagram

V. SOFTWARE SPECIFICATIONS

To run this system, we'll configure and process data from our sensors using the Arduino programming language. The Arduino IDE (Integrated Development Environment) will be used, which is an open-source platform for coding, debugging, and uploading code to the Arduino board.

The Python programming language will also be used for our local server and to communicate with the Arduino board. Python is a popular programming language with numerous libraries and frameworks that will be useful in the development of our project. MySQL, a prevalent relational database management system, will be used to store and manage our data. We'll be able to organize store all of the sensor data and quickly access it when we need it.

ǴUI we used flask, a python based light weight backend-framework. We have fetched data from Arduino using pyserial library then processed the data. For frontend Next.js with typescript has been used. We utilized React-Google-chart library represent the data as graph.

The programming language Python will be used for local server and communication, and the Arduino programming language will be used for sensor configuration and data processing.

VI. SIMULATIONS AND RESULTS

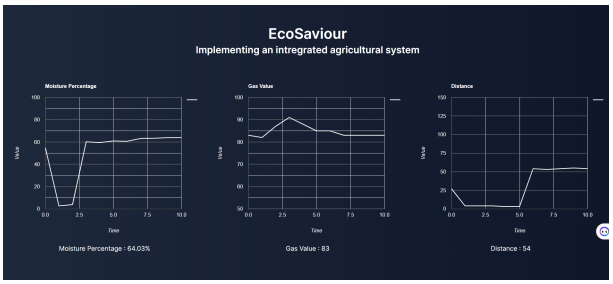

Fig. 2. simulation results from sensors (GUI)

VII. CONCLUSION

Finally, the Arduino-based autonomous plant irrigation system with built-in message alerts offers a complete solution for improving plant maintenance and water efficiency. This project uses a variety of components, including ultrasonic sensors, soil moisture sensors, motor drivers, LCD screens, LEDs and more to accomplish its goals.

The incorporation of ultrasonic sensors makes it possible to assess the water level accurately, resulting in effective irrigation. Intelligent watering depending on the needs of the plant is made possible by the irrigation logic that has been developed and the soil moisture sensor. The temperature and humidity sensor keeps an eye on the weather, which promotes health plant growth.

The correctness and dependability of the system are confirmed through thorough testing and calibration. The system may be monitored and managed by users with ease thanks to the user-friendly interface, which includes LCDs, LEDs, and virtual terminals.

This study highlights the possibilities for water conservation, enhanced plant health, and sustainable agriculture practices in addition to showing how different components can be successfully integrated. The use of automated irrigation systems has the potential to completely change how plants are tended to, opening the door for later improvements like the incorporation of cutting-edge AI algorithms for predictive irrigation.

REFERENCES

[1] K.Srikar ,M.Akhil ,V.Krishna reddy," Execution of Cloud Scheduling Algorithms",International Innovative Research Journal of Engineering and Technology, vol 02, no 04,pp.108- 111,2017.

[2] Y. Kim, J. D. Jabro, and R. G. Evans, —Wireless lysimeters for realtime online soil water monitoring, Irrigation Sci., vol. 29, no. 5,pp. 423–430, Sep. 2011.

[3] K. Taneja and S. Bhatia, "Automatic irrigation system using Arduino UNO," 2017 International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2017, pp. 132-135, doi: 10.1109/ICCONS.2017.8250693

[4] K Automatic watering system with Arduino. (n.d.). Automatic Watering System With Arduino. https://www.robotique.tech/robotics/automatic-watering-system-with-arduino/.