

Automated Preventive Health alerting System for Humans using IoT Based Insect Detection in Water Tanks

Narendra B¹, Shiv Bhagwan O², Sirisha G³, Harisha N L A⁴, Vaseema Taslim MD⁵, Suman Polaki⁶
^{1,2,3,4,5} Ramachandra College of Engineering, Eluru Andhra Pradesh-534007.

⁶Department of Biotechnology, Centurion University of Technology and Management, Vizianagaram, Andhra Pradesh,

Abstract— The IoT water tank insect detector system is an advanced system which uses advanced sensors and data processing solutions to monitor and detect the presence of insects, such as mosquitoes, in water tanks. The system has the capability of identifying the insect activity or breeding conditions using ultrasonic, infrared and camera sensors. The sensor collected data is calculated using a microcontroller and sent to a cloud platform where it is analyzed in real-time using machine learning algorithms. This will make easy to identify and classify insects accurately, and an automatic notification is provided to the user in either a mobile application or a web interface. The system is useful in avoiding outbreak of waterborne diseases as it assists in the early detection and immediate intervention besides giving convenience to the user in monitoring activities remotely. In spite of possible drawbacks like false positives and environmental conditions, the IoT-based solution provides a proactive method of water tank maintenance and insect management.

Keywords: IoT based insect detection, Monitoring water tanks, Insect alert systems, Real-time monitoring, Drinking water safety, Preventive health, water-borne disease, public health

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1. Introduction

Most families, industries and farms cannot be without water tanks which serve as a storage facility of drinking water and irrigation. Yet, the water tanks get contaminated with harmful environmental elements of which the risk of insect contamination is one of the most apprehensive. Other than reducing the quality of the water, the insects can significantly affect the life of man negatively by introducing disease. Mosquitoes, flies, and other water larvae are some of the common insects that occur in water tanks. It is important to detect such infestation early to ensure provision of safe water and maintenance of hygienic standards. Due to the creation of the Internet of Things (IoT) technology, it becomes possible to develop automated insect monitoring and detection systems in water tanks at the moment. These IoT based solutions make use of sensors, real time data collection and remote monitoring to provide

early detection of the presence of insects so that necessary steps can be taken immediately to avert the problem. So, it is insect detection based on internet of things (IoT) of tap water tanks which assists in detecting the insects in real-time and issues automated alerts hence preventing the water contamination and ensuring the safety and quality of drinking water. The study targets design and development of an IoT-based insect detector system of water tanks that will be used to offer real-time insect detection, automatic alerts, and avoidance of contamination hence maintaining the quality and healthiness of drinking water. This involves machine learning and computer vision to detect insects, pick IoT sensors and technology to be used in real-time detection, design of automated alerts and notifications, and the identification of parameters altering the accuracy and reliability of the system. The aims include the planning and creation of IoT insect detection systems on water

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tanks, evaluation of the detection performance and feasibility with regard to insects, and the research on the performance of automated alerts in water contamination prevention. The implications of the current research are to ensure the availability of safe and clean drinking water, to nullify the water pollution and health hazards associated with the same, and to also ensure the water tanks are properly managed. That is, the current research is a blessing to the intelligent water management system, which influences the health of people and the sustainability of the environment.

2. Literature Review

P. S. Asolkar and S. S. Sherekar, paper Digital Farming: IoT Enabled Smart Sensor Based Insect and Animal Detection System (2021): In this article, an IoT system, which is an Arduino UNO kit with various sensors, such as acoustic, IR, and UV sensors, has been employed to detect insects and mammals in farming lands. It emphasizes sensor fusion as part of enhancing the data of detection. The water tank monitoring can be adapted to the detection methods that are used to detect insects in agriculture. [2] It is significant to have information on water quality parameters in order to know the conditions that will attract or promote breeding of insects in water tanks.

[3] Smart Water Management Systems: IoT Based: A Systematic Review by S. S. Gill et al. (2020): It is an article where the authors review the applications of IOT in smart water management and discuss the use of controllers, sensors, and applications to display the information. The results on sensor implementation and data processing may be applied to come up with an insect tracking system on water tanks.

Vaishnavi V. Daigavane, [4], IOT Based Water Quality Monitoring and Flow Control of Tank Water. The present paper presents a system that is based on IoT, which measures such water quality parameters as temperature, pH, and turbidity. It also includes water flow control mechanisms that work on sensing data. Observation of these parameters helps to identify situations that may evolve into the insect

infestation of tanks with water.

N. A. Christopher et al. (2021): AIP, Water tank level monitoring system based on IOT using ultrasonic sensor. The problem addressed in this article is connected to the water tank monitoring via the application of ultrasonic sensors with the help of IOT to send the data in real-time and trigger alerts. The conditions favorable to insect breeding can be avoided by keeping the water levels in their best condition and being monitored. These papers are a fair foundation towards understanding how IOT, sensor technologies and monitoring systems are integrated with regard to the creation of an insect detection system in water tanks..

3. Components

In the given project, the Arduino Uno is the focal controller in the detection of insects in a water tank. It reads the input of the sensors attached to it, like an ultrasonic sensor or IR sensor, which detects any movement or action around the water surface and this signals the possibility of insect intrusion. Also, the Arduino has the ability to read a turbidity sensor to detect the variation in the clarity of water, which can be used to determine contamination.

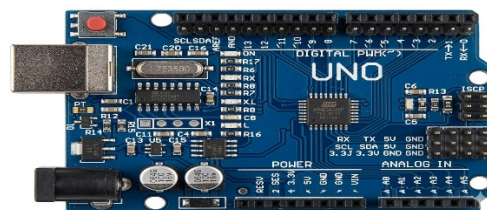


Fig.1. ARDUINO UNO

Embarkation of an LCD is essential in improving the usability of the system since it provides real time and on-site monitoring without any external devices, i.e. computers or smartphones. The 16x2 LCD has the ability to show two lines having 16 characters in each line and hence suitable in small systems with minimal space. I2C interface module greatly eases the wiring since the 16 connections are brought down to only 4 (VCC, GND, SDA, and SCL), which can be used to save the Arduino board GPIO pins to other.

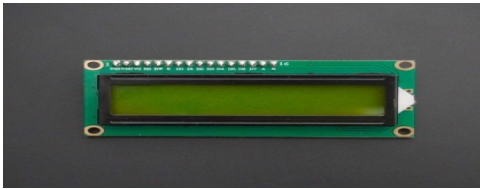


Fig.2.LIQUID CRYSTAL DISPLAY

The insect detection system employs the DHT sensor (either DHT11 or DHT22) to detect the level of temperature and humidity in the environment of the water tank. The insects can also be affected by these environmental factors since most insects thrive in warm and wet climates. Combining the DHT sensor with the Arduino Uno, the system would be able to monitor real-time environmental data and show it on an LCD screen or utilize it as a component of the logic to give alerts. Input of sensor data water quality, DHT sensor (temperature and humidity).



Fig.3.

DHT SENSOR

An LED is employed in this project as a basic but efficient visual representation of warnings. The Arduino Uno can be used to provide users with instantaneous notification of the potential presence of a bug, based on sensor readings (e.g. movement of an ultrasonic or IR sensor, turbidity of the water, or conditions of a DHT sensor, etc.). This provides a quick and easy to see warning especially in areas where there is no display or internet.



Fig.4.LIGHT-

EMITTING DIODE

In this project, the system identifies the use of A buzzer as a sound alert system that derives the immediate attention of the users when an insect activity or water contamination is detected. On a peculiar state of affairs, the Arduino Uno causes the buzzer to sound, e.g. when the water surface suddenly starts moving or the water is not clear enough, the Arduino causes the buzzer to make a sound to get people to pay attention. This makes the system more sensitive especially in noisy or outdoor environment where visual signals like LEDs would not be noticed.



Fig.5.BUZZER

The insect alert system consists of sensors that sense the presence of insects in the water tank and instantly turn on a LED, buzzer and display a message on LCD. In addition to this local alert, the system also sends this user an automatic Gmail notification, which will keep the user informed even when they are not around. This aids in rapid response in order to sustain water hygiene.

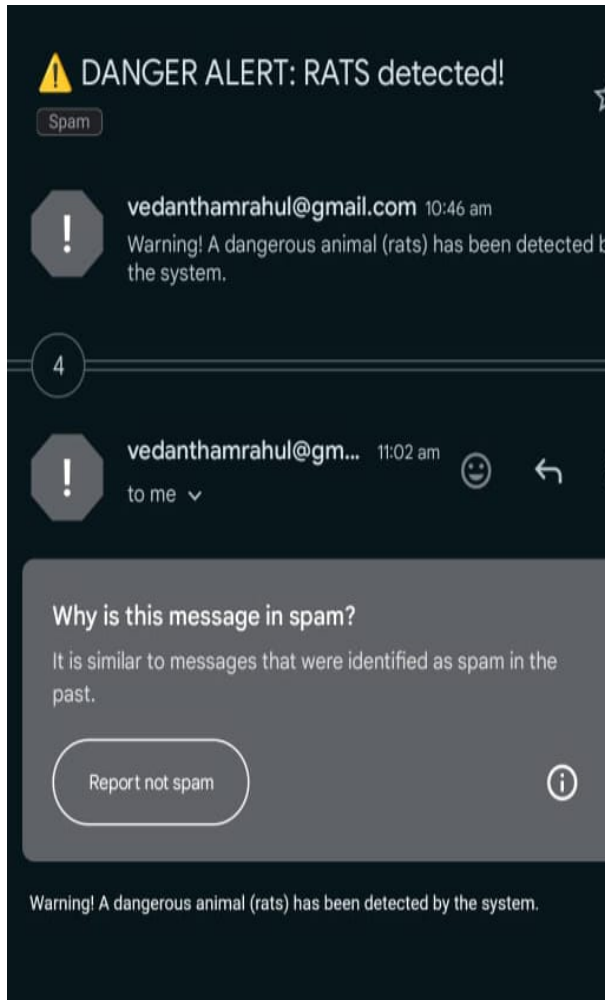


Fig.6. GMAIL

It has a vital application in embedded systems and prototyping since it offers a platform that is accessible, easy to use by beginners, and accessible to electronics enthusiasts, students, and professionals alike. The IDE has programming languages of C and C++, with a simplified API that hides the complexity of the low level so that it is easier to manipulate hardware components.

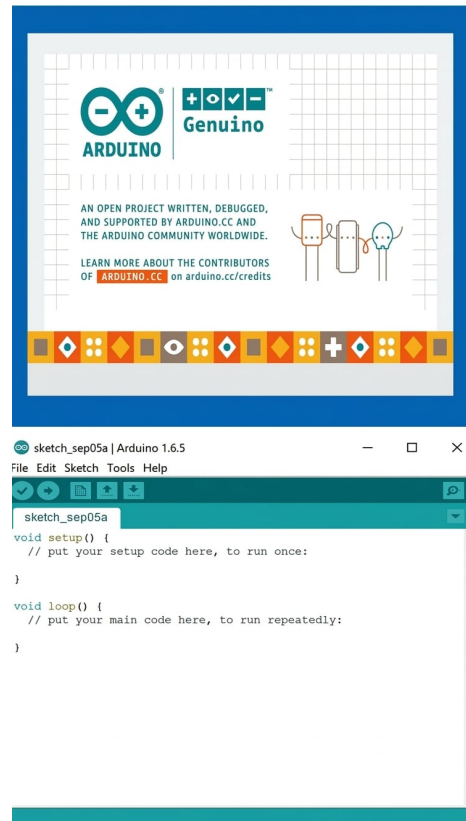


Fig.7. Arduino Uno

4. Methodology

A water tank with a capacity of a thousand liters was used to control the environment with a one-thousand-liter capacity- An Arduino Uno board with a camera module attached to it- LED indicator and a buzzer upon detecting an insect- Image-processing using OpenCV to identify insects- Uploading Data to Thing Speak to monitor the environment remotely. Installation of Multiple Sensors to sense water tank. Install all the hardware and make them attach to the Arduino Uno board. Program the Arduino Uno board with the assistance of Arduino IDE. Add insects to the water tank and take pictures of them after every few minutes. Image Capture Operations Sensor Data Collection. When insect is Following the proceeds will be initiated by the alert system and the procedures will be Instrumentation Setup [1]. Install Water Tank: This should be done so as to allow a 1000 liter water tank in a controlled setting [2]. Connection of Arduino Uno: Connect Arduino Uno to camera module and sensors, LED lights and a

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buzzer. Combined to OpenCV Image Processing Library: combining processing using the OpenCV library.[3]. Image Capture: It enables one to capture an image of the water tank through the camera module. [4]. Image Processing: It performs an insect detection on images that have been taken with the help of OpenCV. Insect Detection: Processed Image Insect Detection.

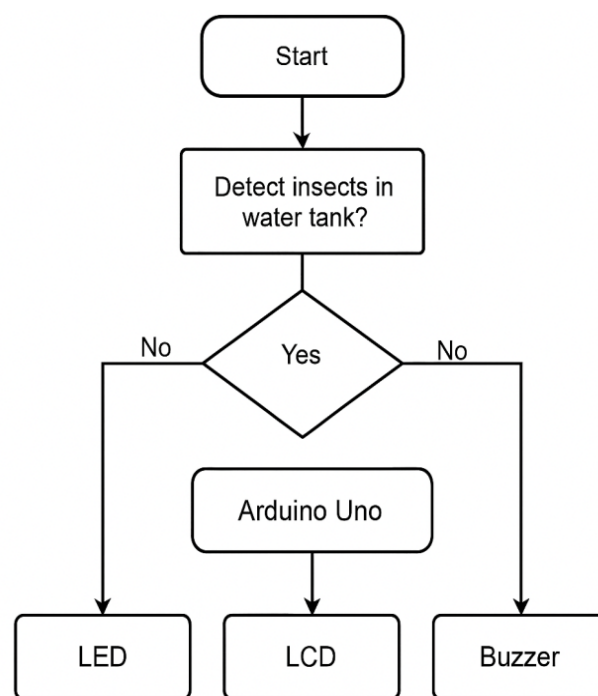
5. Proposed Method

This proposed method involves the development of a smart insect detection and alert system of water tanks using Arduino Uno and sensors. There is a collection of sensors installed in the system that monitors the water tank on the regular basis to detect any signs of insect infestation or water contamination. An ultrasonic or IR sensor detects motion or agitation on the water surface which can be caused by insects. A turbidity sensor is used to check the clarity of the water, and this can be used to identify any unusual contamination of the water. The sensor is a DHT11 that monitors an environmental condition that is likely to attract insects, e.g. temperature and humidity. Each sensor is connected to the Arduino Uno which processes the readings and determines whether or not any cross is defined to cross over any of the set thresholds. In case of abnormal values, e.g. high turbidity or unexpected movement, the system activates an LED and buzzer to provide local notification. A LCD screen is also used to show real time sensor values and alert messages. It is a cheap, real-time, and automated method of ensuring the hygiene of water tanks and preventing contamination by insects.

6. Working

The system will be able to detect the movement of insects and measure the quality of water in a water tank according to an Arduino Uno as the primary microcontroller. Once it has been started, the system reads real-time information on the sensors that are attached. The ultrasonic sensor detects all the disturbances on the surface of the water such as ripples or movement that could indicate the existence of insects.

Meanwhile, the turbidity sensor measures the clarity of the water to determine whether it has been contaminated by insects breeding or decomposing organic things. DHT11 sensor keeps track of the environmental humidity and temperature and these are factors that may foster breeding of insects around and inside the water tank. Real-time sensor readings and warning messages are displayed on a 16x2 LCD display to enable easy observation of the state of water tank locally by the users.



Fig

8. Working

7. Experimental Analysis

In order to test the functionality and precision of the new water tank insect detection system, a series of tests was performed with major components: Arduino Uno, turbidity sensor, and DHT11 sensor. In order to simulate the real-life conditions, which may lead to insect activity and contamination, the system was tested in the controlled environment of the water tank. To simulate the pollution, turbidity sensor testing was done by adding organic impurities (i.e., tea powder or leaves) gradually to clean water. The turbidity sensor was used to detect the increased turbidity values correctly and forwarded analog

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signals to the Arduino Uno, which interpreted the values based on predetermined values. In case the turbidity went beyond the safety level, the LED light and the buzzer were turned on to give a brief visual and sound alert. The experimental measurements showed that sensor readings were constant in different environmental conditions. The LCD screen was used to give real-time readings of the turbidity and the environmental conditions such that the user could monitor the quality of water in real-time. The system was found to be reliable in any test scenario. It responded in a predictable way in case the turbidity level was elevated, or in case the conditions were within the bounds conducive to insects.

8. Power Supply

A USB Type-B cable is required to connect the Arduino Uno to a computer in order to make the Arduino Uno powered, and be able to program it. It is the standard cable supplied with the majority of Arduino Uno boards that has a Type-B connector (square-shaped) on one side of the cable with a Type-A connector on the opposite end to be inserted into a laptop or desktop computer. Data Communication- It allows the code (sketches) written in Arduino IDE to be uploaded to the board. In a free or permanent installation (not attached to a PC), the Arduino Uno may be supplied by a regulated power supply (RPS). The board is in favour of a DC barrel jack with 7V to 12V range of voltage.

9. Results and Discussion

The DHT sensor (DHT11 or DHT22) is a temperature and humidity sensor, which is commonly used in IoT projects and environmental monitoring projects. The sensor measures by using a thermistor as a temperature sensor and capacitive sensor as a humidity sensor. Information is transmitted digitally and time-based with each bit being encoded in the duration of a high pulse. This information is read and translated into the readable values by the microcontroller as temperature (in degrees Celsius) and humidity (as percentage). It is easy to operate, requires a single data line to

communicate and uses either a 3.3 V or 5 V power source. The DHT11 is suitable to the simple projects with a reasonable accuracy, but the DHT22 is more accurate and has a longer range of operation, thus it is better suited to sensitive devices.

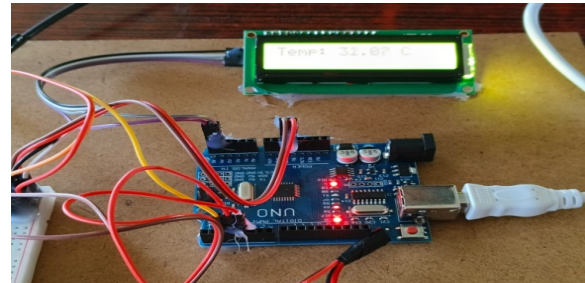


Fig.9. Temperature

The LCD of the water tank monitor shows the status as normal meaning that the system is normal and no insects are present in the tank. The water is clean and does not show any sign of being infested or contaminated by insects by its visual appearance. It is evident that the tank is healthy and safe at the given moment. The sensors and the monitoring elements would most probably be working as intended and such the detection would be accurate and the LCD updated in real-time.

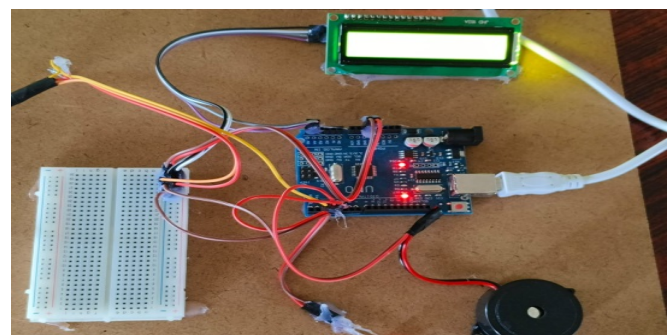


Fig.10. NORMAL:

There is no insects in water

This is a grave issue and that needs immediate concern in order to make the water safe to use. The water can be contaminated by insects and will be unsafe to drink, cook or take a bath. The water supply first needs to be shut off immediately to avoid further use. The tank must

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be emptied to the last, cleaned and disinfected to remove any potential contaminants. The tank should also be checked in the form of crevices or holes that might have facilitated the entry of the insect. The tank must then be filled up with clean water after cleaning and effective safety measures such as mesh screens and covered lids must be installed to prevent additional infestation. Checks and maintenance are also important so that the water is constantly clean and safe.

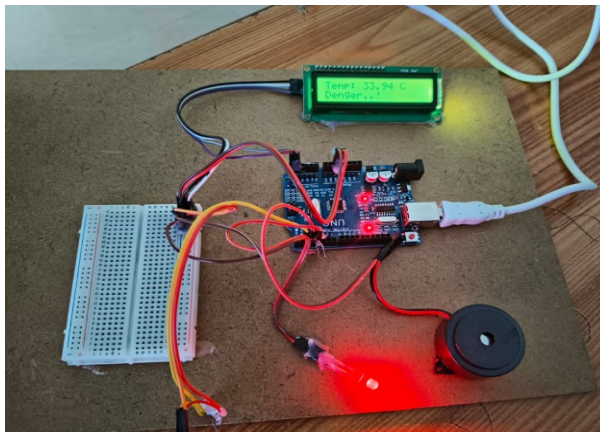


Fig.11. DANGER

There is insect in water tank

10. Conclusions

The proposed IoT water tank insect detector system is an economical, efficient and reliable way of detecting insect activity and tracking the water quality. By the usage of the Arduino Uno as the main controller, and the usage of other sensors such as the turbidity sensor and the DHT11, the system can effectively measure the key parameters, including the clarity of the water, temperature, and humidity. The results of the experiment support the ability of the system to detect early signs of water contamination that is significant in avoiding the spread of diseases that are caused by insects breeding in stored water. Its design is simple and entirely functional in the absence of the internet, which is why it can be used in rural and resource-poor environments. Overall, this project contributes to the clean water storage processes, enhances the level of safety among the population, and can become the

foundation of further more advanced and automated water monitoring devices.

11. Future Scope

The proposed insect detection system of water tanks, though primitive and inexpensive now, has a lot of potential in upgrade and development in the future. At later development phases, wireless connectivity can be added to the project with the use of modules like ESP8266 or Node MCU to support real-time remote monitoring and mobile alerts through the IoT platforms like Blynk, Thing Speak, or Firebase. Automatic disinfection systems can be installed like chemical dispensers or UV sterilizers and be automatically turned on in case contamination is detected. The system also could be made scalable to be used in large-scale facilities of water storage, municipal water reservoirs, and irrigation systems of agricultural plants, where the consequences of contaminated water directly affect the health of the population or crop production. The combination with solar power allows making the system energy efficient and using it in off-grid or rural settings where power is not readily available. These advances can make the system a smart, autonomous water quality and pest control system, which will have a substantial contribution to the overall practices and health of the people in the water management practice.

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