**A notification and shutdown system for water pumps using**

**Internet of Things (IoT) technology**

Thammanit Nooyimsai1, Chayut Sapphakhao1

Advisors: Thapanawat Chooklin1

1Princess Chulabhorn Science High School Nakhon Si Thammarat, 120 Village No.1 Sunanan Road, Bangchak

Subdistrict, Mueang Nakhon Si Thammarat District, Nakhon Si Thammarat 80000, Thailand

\*E-mail: [t.lookmee@pccnst.ac.th](mailto:t.lookmee@pccnst.ac.th)

This project presents a water pump monitoring and automatic shutdown system utilizing Internet of Things (IoT) technology to prevent potential damage caused by pump malfunctions, such as dry run conditions or excessive power consumption. The system detects the pump’s status through a flow switch sensor and a PZEM-004T power measurement sensor, sending real-time alerts to users via the LINE application. Additionally, it can automatically shut down the pump when abnormalities are detected. The system is designed with configurable settings, including pump shutdown delay, power consumption limits, and a protection mode (Protect Mode), all accessible through a user-friendly interface. Real-time notifications enable users to monitor and control the pump remotely. Testing results indicate that the system effectively reduces the risk of pump damage, minimizes maintenance costs, and enhances water management efficiency. This project can be applied to water pump systems in households, agriculture, and industrial sectors, improving safety and optimizing water usage.

**Keywords :** Internet of Things (IoT), Alert System, Automatic Shutdown, Dry Run, LINE, Blynk, Flow Switch Sensor, Power Measurement Sensor.

**1. Introduction**

Water pumps are essential components in both residential and agricultural applications, where they are used to facilitate water distribution for various needs such as irrigation, household supply, and industrial processes. However, despite their importance, water pumps are prone to operational failures, especially under abnormal conditions such as **dry-run** (operation without water flow) and **excessive power consumption**. These malfunctions not only cause significant damage to the pump hardware but also lead to unnecessary energy waste, high maintenance costs, and operational downtime. In recent years, the **Internet of Things (IoT)** has emerged as a transformative technology in the field of automation and remote monitoring. By integrating sensors, microcontrollers, wireless networks, and user interfaces, IoT enables real-time data collection, analysis, and control of devices remotely through mobile applications. This advancement provides an opportunity to develop intelligent systems that can enhance the efficiency, safety, and sustainability of traditional devices such as water pumps. This project focuses on designing and implementing an IoT-based **notification and automatic shutdown system for water pumps**. The system leverages two main sensors: a **Flow Switch** to detect water movement in the pipe and a **PZEM-004T module** to monitor power usage. The central controller is a **NodeMCU ESP8266** microcontroller, which processes sensor data and triggers alerts and pump shutdown based on user-defined thresholds. Alerts are sent in real-time via the **LINE Notify** service, and users can monitor and configure the system through the **Blynk Legacy** mobile application and an onboard **LCD display**. By enabling real-time detection and response to operational anomalies, this system aims to protect pumps from potential damage, reduce maintenance costs, and enhance overall water management. Its scalability makes it applicable across households, farms, and industrial sectors.

**2. Framework**

The proposed system architecture consists of:

* Sensors: Flow Switch and PZEM-004T to monitor water flow and power consumption.
* Microcontroller: NodeMCU ESP8266, serving as the central processing unit.
* Interface: Users interact via Blynk Legacy and receive alerts through LINE Notify.
* Protection Logic: Includes real-time monitoring, configurable thresholds, and automated pump cutoff via relay when anomalies are detected.
* User Control: A keypad and LCD display provide local configuration capability, while the mobile app allows remote access.

The system is modular and cost-effective, suitable for multiple scales of deployment.

**3. Findings and Discussion**

1. Successfully integrated a flow switch and PZEM-004T sensor to monitor

operational conditions of the pump.

2. Developed logic using Arduino IDE to process sensor data and trigger automated actions through the ESP8266 board.

3. Integrated LINE Notify API to push alerts upon detecting dry-run or high energy usage.

4. Developed a Blynk-based mobile interface allowing users to

4.1 Set thresholds for pump cutoff.

4.2 Enable/disable “Protect Mode”.

4.3 View real-time operational metrics.

5. Designed a complete enclosure with pilot lamps, relay modules, and safety switches. Installed successfully in a test water system.

6. Conducted tests covering

6.1 Accurate abnormality detection.

6.2 Reliable automated shutdown.

6.3 Real-time alerts and configuration changes.

6.4 Performance under varying flow and electrical conditions.

7. Challenges Encountered

7.1 Inconsistent detection under weak internet.

7.2 Occasional misreadings from mechanical flow switches under low water pressure.

7.3 Need for fine-tuning current limits for various pump models.

8. Improvement Strategies

8.1 Recommended ultrasonic or Hall Effect flow sensors.

8.2 Added offline logging and delay buffering for unstable networks.

8.3 Suggested future integration of cloud data storage for analytics.

**4. Conclusion**

The development of this IoT-based notification and shutdown system successfully addresses the critical challenges associated with water pump operations. Through the integration of flow and power sensors, ESP8266-based control, and mobile app interfaces, the system can detect operational anomalies such as dry-run conditions or overcurrent scenarios with high accuracy and reliability. The real-time alert and shutdown mechanisms enhance the safety of the system by preventing damage before it escalates. The user-configurable settings—such as delay times, energy thresholds, and protection mode—enable tailored operation for different pump types and usage environments. Additionally, the system’s ability to send alerts via LINE and provide a centralized control panel through the Blynk platform improves user accessibility and convenience.

Experimentation and field testing demonstrated the system’s robustness in practical scenarios. Users were able to adjust parameters in real-time, receive accurate alerts, and ensure prompt automated response to faults. Moreover, the system contributes to energy conservation, equipment longevity, and better operational oversight. Looking forward, this project sets the foundation for further enhancements such as integrating cloud-based data logging, AI-driven predictive maintenance, and support for multi-pump networks, making it a promising solution for the future of smart water infrastructure in Thailand and beyond.

**5. Acknowledgement**

We would like to sincerely thank our project advisors, Mr. Thapanawat Chooklin and Ms. Kutsalin Thipmanosing, for their valuable guidance and support throughout this project. Their advice was essential in helping us solve technical problems and stay on track during development.

We also extend our appreciation to the teachers and staff of Princess Chulabhorn Science High School Nakhon Si Thammarat for providing resources and encouragement. Special thanks to our friends and classmates for their moral support and helpful suggestions.

This project would not have been possible without the collective assistance and encouragement from everyone involved.

6. References

Ayarafun. (2015). Introduction to Arduino ESP8266 NodeMCU. <http://www.ayarafun.com/2015/08/introduction-arduino-ESP8266-nodemcu/>

AI Corporation. (2021). What is Arduino IDE?.

<https://www.ai-corporation.net/2021/11/18/what-is-arduino-ide/>

Sanook Guru. LINE Application Overview. <https://guru.sanook.com/8790/>

Blynk. Blynk IoT Platform. <https://blynk.io/>

AB Electronics. LCD 20x4 Display Explanation. <https://www.ab.in.th/article/57/>

AnalogRead. NodeMCU ESP8266 Code Sample. <https://www.analogread.com/article/90/>