IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, April 2026
Impact Factor: 8.2

Solar-Powered Smart Flood Management and Drainage System Using IoT

Aman Dinesh Nerkar[1], Samidha Devidas More[2], Naitik Mahesh Malakar[3], Vaishnavi Bhaskar Gamane[4], Prof. Abhijit Sopan Mehetre[5], Prof. Ganesh Satish Gujrathi[6], Prof. Prashant Ganpat Chavan[7]

Students, Department of Civil Engineering[1-4]
Lecturer (Guide), Department of Civil Engineering[5]
Lecturer (Co-Guide), Department of Civil Engineering[6]
Head of Department (HOD), Department of Civil Engineering[7]
Guru Gobind Singh Polytechnic, Nashik, Maharashtra, India

Abstract: *Urban flooding is a recurring disaster worsened by inadequate drainage, clogging, and power failures. This paper presents a solar-powered smart flood management and drainage system that integrates IoT-based monitoring, automated debris removal, and renewable energy. An ultrasonic sensor continuously measures water levels and triggers a DC submersible pump when a preset threshold is crossed. To prevent clogging— the primary cause of drainage failure—a two-stage filtration unit (coarse and fine screens) is installed upstream. A motorized horizontal arm periodically cleans the screens, and a differential pressure sensor detects blockages. If self-cleaning fails, an alert is sent to the Municipal Control Centre via GSM/Wi-Fi. The entire system operates on solar energy with battery backup, ensuring functionality during grid outages. A flexible hose with strainer allows water extraction from uneven terrain lacking formal drainage. Experimental results confirm water level sensing accuracy within ±1 cm, automated pump activation within 2 seconds, successful clog detection and alert transmission, and reliable solar charging. The proposed system reduces manual intervention, prevents drain clogging, and provides real-time remote monitoring. It offers an energy- efficient, eco-friendly, and scalable solution for smart city flood management, aligning with sustainable development goals.*

Keywords: IoT, ultrasonic sensor, Arduino, solar energy, self-cleaning screens, clog detection, municipal alert, flood management

I. INTRODUCTION

Urban flooding has become a critical global challenge due to rapid urbanization, encroachment on natural drainage, increased impervious surfaces, and climate change-induced extreme weather events. Traditional drainage systems suffer from three fundamental limitations: (i) manual cleaning that fails during heavy rainfall, (ii) dependency on grid power, and (iii) lack of real-time situational awareness. Consequently, even moderate rainfall often leads to waterlogging, property damage, and loss of life.

Recent advances in Internet of Things (IoT), low-cost sensors, and renewable energy offer opportunities to transform passive drainage infrastructure into intelligent, autonomous systems. Several IoT-based flood monitoring systems have been proposed [1], but most focus solely on sensing and alerting without active water removal or debris management. Mechanically cleaned bar screens are standard in wastewater treatment plants [2], yet their adaptation to stormwater inlets with solar power and IoT remains limited. Solar water pumping is mature [4], but its integration with automated flood response and IoT communication is unexplored.

This paper presents a comprehensive system that addresses these gaps through four integrated subsystems: (1) real-time water level sensing and automated pumping, (2) two-stage filtration with self- cleaning mechanism, (3) clog detection and remote municipal alerting, and (4) solar power with battery backup. A flexible intake option extends applicability to areas without formal drainage. The system is designed as a modular unit for smart city deployment.

II. PROBLEM STATEMENT

Urban flooding is intensifying due to rapid urbanization, encroachment on natural drainage, increased impervious surfaces, and climate change-induced extreme rainfall. Conventional stormwater drainage systems exhibit three critical limitations: (i) reliance on manual cleaning, which fails during heavy rainfall events; (ii) rendering them inoperative during outages; and (iii) absence of real-time situational awareness, preventing proactive response. While recent IoT-based flood monitoring systems have emerged, they focus predominantly on sensing and alerting, neglecting active water removal and debris management. Furthermore, although mechanically cleaned bar screens and solar water pumping are mature technologies individually, their integration into a unified, autonomous, solar-powered, IoT-enabled stormwater inlet system remains unexplored. Consequently, even moderate rainfall frequently causes waterlogging, property damage, and loss of life. There is a clear need for a self-contained, intelligent drainage unit that combines real-time sensing, automated pumping, self-cleaning filtration, clog detection, remote alerting, and renewable energy to overcome the shortcomings of passive drainage infrastructure.

III. METHODOLOGY

A. Working Principle

The system comprises four main units :Sensing Unit: Ultrasonic water level sensor (HC-SR04), differential pressure sensor (MPXV7002DP) for clog detection. Debris Management Unit: Coarse screen (25 mm spacing), fine screen (5 mm openings), 12V DC gear motor-driven horizontal cleaning arm with brushes, debris collection bins.

B. Pumping Unit :

1. Pump: 1 HP (746 W) AC submersible pump (15,000–20,000 L/h, 8–10 m head) with pure sine wave inverter (1.5 kVA).
2. Solar Array: 1.5 kWp (6 × 250 W panels).
3. Battery Bank: 48 V, 200 Ah deep-cycle (9.6 kWh usable at 50% DoD).
4. Charge Controller: 48 V, 40 A MPPT.
5. Grid Backup: 48 V, 30 A automatic grid charger.
6. Automatic Transfer Switch (ATS): Arduino/PLC-controlled for seamless switching between solar/battery and grid.
7. Flexible Intake: 1-inch hose with strainer for areas without formal drainage.
8. Communication & Control Unit: Arduino Uno (or PLC for industrial scale), SIM800L GSM module, ESP8266 Wi-Fi, ThingSpeak cloud dashboard, relay modules for ATS and cleaning arm control.

IV. CONCLUSION

This paper presented a Solar-Powered Smart Flood Management and Drainage System that integrates IoT sensing, automated debris management, renewable energy, and remote alerts. The system successfully addresses the core failure modes of conventional drainage: clogging (via self-cleaning screens and differential pressure detection), power dependency (via solar+grid backup), and lack of real-time information (via GSM/Wi-Fi dashboard). The system reduces flood risk, minimizes manual intervention, and provides sustainable, scalable infrastructure for smart city flood resilience. Future work includes adding bin fill-level sensors, solar tracker for increased energy harvest, and AI-based predictive pump scheduling using rainfall forecasts

V. ACKNOWLEDGMENT

The thank the faculty of Guru Gobind Singh Polytechnic, Nashik for their guidance and support. They also acknowledge , Google, and Research Gate for providing open and accessible tools that made this project possible.

REFERENCES

[1] S. Patil et al., "IoT Based Flood Monitoring and Alerting System," Int. J. Eng. Res. Technol., vol. 11, no. 4, pp. 45–49, 2022.

[2] Water Environment Federation, Design of Mechanically Cleaned Bar Screens, WEF Manual of Practice No. 8, 2019.

[3] A. Kumar et al., "Solar Powered Self-Cleaning Trash Rack for Canals," J. Irrig. Drain. Eng., vol. 147, no. 8, Art. no. 04021035, 2021.

[4] Ministry of New and Renewable Energy, Government of India, Guidelines for Solar Water Pumping Systems, 2020.

[5] National Institute of Disaster Management, Urban Flood Management in India: Challenges and Strategies, New Delhi: NIDM, 2020.

[6] Arduino Official Documentation, 2025. [Online]. Available: www.arduino.cc 7] ThingSpeak IoT Platform, 2025. [Online]. Available: thingspeak.com