Project Title: Smart Semi-Automatic Menstrual Waste Incinerator

Team Name: FEMTech Forge

College Name: Anurag University

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Chosen SDG Target

SDG 12: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse (Target 12.5).

Secondary SDGs: 3 (Good Health & Well-being), 5 (Gender Equality), 6 (Clean Water & Sanitation)

We focus on SDG 12, particularly targets 12.2 (environmentally sound management of chemicals and all wastes throughout their life cycle) and 12.4 (reduce release of hazardous chemicals to air). Menstrual waste is an under-explored rural issue that intersects these targets.

Problem Statement

Rural schools in India lack any facility for hygienic disposal of menstrual waste. Students resort to open burning or improper dumping, leading to:

Health Risks: Over 58.5 billion sanitary pads are discarded annually in India, with rural regions lacking proper disposal infrastructure. Most rural Indian schools lack any sanitary-napkin disposal facility, forcing girls to burn pads in the open or discard them in fields. This exposes them to infections, unpleasant environments, and social stigma.
Environmental harm: Sanitary pads are composed of plastics and cellulose; they take 500–800 years to decompose and produce harmful toxins when burned improperly.
Social Impact: Studies report up to a 23% drop in girls' school attendance on menstrual days due to inadequate disposal facilities and privacy concerns.
- The rapid growth in pad usage—over 200 million users nationwide—exacerbates waste accumulation without sustainable solutions.

Detailed Description of the Problem

Causes:
- Absence of disposal bins or incinerators in rural school toilets.
- Limited awareness of menstrual hygiene management (MHM).

Impacts:

- Respiratory and skin illnesses from inhaling smoke and contact with contaminated waste.
- Soil and water contamination affecting broader community health.
- School absenteeism and dropout rates among adolescent girls, perpetuating gender inequality.

Stakeholders:
- Girls and school staff.
- Local health workers and panchayats.
- Panchayat bodies and NGOs engaged in WASH (Water, Sanitation, Hygiene).

Local Relevance:
Rural districts often report no formal waste collection for menstrual products. Community surveys indicate over 70% of pads are either burned in open pits or discarded in fields in pilot study areas.

Proposed Solution & Objectives

Proposed Solution

We will integrate a lightweight software layer to automate and monitor the incinerator's operation:
- Arduino firmware will manage ignition and ventilation in a fixed sequence (e.g., 10 minutes heating, 1 minute venting) via a single button press.
- Each cycle's start and end times will be logged to onboard EEPROM or SD card for later review.
- Status LEDs will indicate states (ready, burning, cooling) and an emergency-stop interrupt will ensure user safety.

Phase 2: Mobile App Integration

- A React Native app will connect over Bluetooth to trigger cycles and show remaining time.
- Users can download the last 30 days of cycle logs as a CSV file.
- The app will display live status and send basic alerts (e.g., incomplete cycle, no activity for 48 hours).

Phase 3: Cloud Dashboard

A Node.js and Firebase dashboard will optionally sync data to:
- Visualize daily usage trends and flag devices with stalled cycles.
- Support future AI models for maintenance prediction.

Project Objectives

- Automate the burn cycle so non-technical users can safely operate the unit with one button press.

- Enforce a maximum run time and include an emergency-stop interrupt to prevent unsafe operation.

- Log cycle data locally to aid on-site diagnostics without specialized tools.

- Provide basic remote control and log access via a smartphone app to minimize in-person checks.

- Ensure the software architecture supports easy addition of cloud sync, alerts, and AI-based maintenance predictions.

Detailed Explanation of the Solution

Technical Design:

- Chamber: 300×300×400 mm sheet-metal box, optionally insulated with clay bricks or ceramic fiber.
- Heating: 1 kW nichrome coil, controlled by Arduino via a 5 V relay.
- Airflow: 12 V exhaust fan activated after combustion; vents smoke through a vertical chimney (~2 m).
- Control Unit: Arduino Uno, relay module, push-button, and status LEDs (Ready, Burning, Cooling).
- Ash Tray: Removable stainless-steel pan collects residue after each cycle.

Software Workflow:

1. User drops in pad and presses the start button.
2. Arduino activates the heater for a timed cycle (default: 10 minutes).
3. Once heating ends, the fan runs for 1–2 minutes to clear residual smoke.
4. LEDs show current status; ash is collected safely in the bottom tray.
5. Optional: Logs are stored (in EEPROM or SD card) and can be retrieved via USB or Bluetooth.

The software stack will include Arduino IDE (C/C++) for firmware, React Native for the mobile app, and Node.js with Firebase for the cloud dashboard.

Interdisciplinary Elements:

- Computer Science: Firmware design, state management, modular logic for control and data logging.
- Electronics: Relay switching, thermal safety, fan and coil power regulation.
- Environmental Science: Smoke handling, emission reduction, and ash disposal or composting practices.

Design Thinking:

- Empathize: Discussions with rural school students and staff to understand disposal challenges.

- Define: Hygiene, safety, and accessibility as key problems to solve.
- Ideate & Prototype: Low-cost mockups tested with real users; software simulations for timing cycles.
- Test: Iterative improvements based on usability, burn efficiency, and maintenance feedback.

	Existing	Our Solution
Feature		
Combustion control	Manual	Software-timed heater + fan cycle
Safety shut-off	None	Thermal cut-off switch + timer fail-safe
Smoke management	Chimney only	Chimney + exhaust fan
Data & alerts	N/A	LED status, future mobile alerts
Scalability	Low (hand-made)	Modular design; plans for local training and NGO partnerships

Proof of Concept

Feasibility and Practicality

Our proposed solution is highly feasible as it uses off-the-shelf, low-cost components and widely adopted open-source software platforms (Arduino IDE, React Native, Firebase). The prototype chamber can be fabricated locally using metal or clay, and all electronics are modular, allowing rapid assembly, testing, and repair. The push-button interface and software-controlled burn cycle make it accessible to non-technical users, including school staff and students.

Existing Solutions and Their Impact

Most existing incinerators in rural schools are either:

- Manual brick-based “burn pits”, which are unhygienic and emit uncontrolled smoke.
- Basic electric incinerators with no automation, timers, or safety shut-offs.

While some commercial models offer automatic features, they are often cost-prohibitive, non-scalable, and lack data-tracking capability.

Our New/Different Approach

Unlike manual or commercial models, our system is:

- Software-timed using Arduino firmware for safe and consistent burning.
- Fitted with status indicators and emergency shut-off for safety.
- Modular and affordable, so it can be locally built and maintained.
- Designed to collect usage data, enabling future predictive maintenance and remote monitoring via mobile and web interfaces.

Expected Outcomes

Short-Term:

- Elimination of open burning practices in pilot schools.
- Improved attendance and hygiene awareness among girls.

Long-Term:

- Scalable adoption by district education bodies and NGOs.
- Data-driven insights inform rural sanitation policies.

Environmental Impact:

- Reduction in PM2.5 emissions and plastic waste.

Social Impact:

- Empowerment and retention of female students in schools.

Resources Required

Materials & Hardware

- Chamber enclosure: sheet-metal box (30 × 30 × 40 cm) or locally fabricated clay-brick lining

- Heating element: 1 kW nichrome coil

- Airflow: 12 V DC exhaust fan and short chimney stub

- Combustion support: perforated steel-mesh grate

- Ash collection: slide-out stainless-steel pan

Electronics & Control

- Microcontroller: Arduino Uno (or compatible)

- Relay module: 5 V, 2-channel relay board (one channel for heater, one for fan)

- User I/O: push-button (“Start”) and two LEDs (Ready, Burning/Venting)

- Safety cutoff: bimetallic thermal switch (≈350 °C)

- Power supplies: 5 V adapter for Arduino/relays; 12 V adapter (or battery) for fan

- Wiring and accessories: insulated wires, connectors, cable glands, fuse or MCB

Tools & Software

- Electronics toolkit: soldering iron, multimeter, basic hand tools

- Firmware IDE: Arduino IDE (C/C++)

- Optional development stack: React Native environment (Phase 2 mobile app), Node.js + Firebase account (Phase 3 dashboard)

Mentorship & Support

- Electrical-safety advisor (mains integration, thermal testing)

- Embedded-systems mentor (firmware review, debugging)

- Local fabrication partner (metal or clay workshop for chamber build)

Prototype Budget Estimate

Approximate cost for prototype components and basic tooling: ₹4,000–5,000

Team Details

Deekshitha Reddy Paduri, 4th year Computer Science & Engineering | Data Logging & Dashboard Dev
Nannapaneni Navya Sri, 4th year Computer Science & Engineering | Electronics & Power Specialist
Gundeboina Dheeraj, 3rd year Computer Science & Engineering | UI/UX & Mobile Integration
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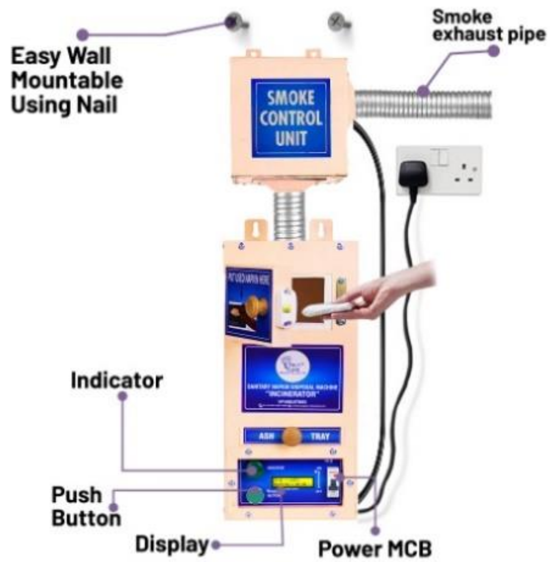
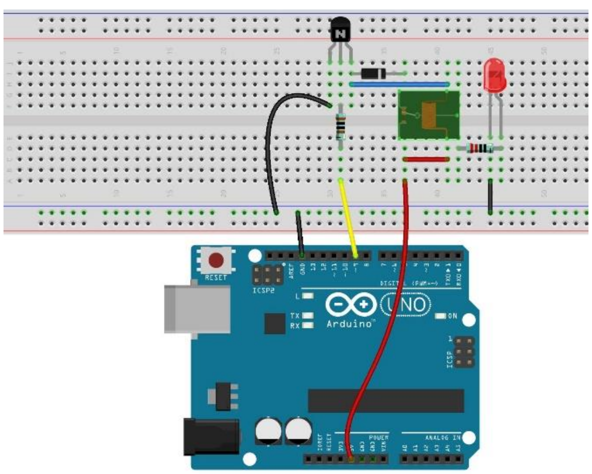
Images & Proofs



Modular chassis with side control panel and exhaust pipe; demonstrates neat separation of hot zone and electronics.



A basic breadboard circuit with Arduino, relay module, and LEDs—mirrors your on-device firmware integration.

Closing Statement

We believe our solution bridges a critical gap in rural menstrual hygiene by combining low-cost incineration hardware with smart, software-driven automation and monitoring. Our interdisciplinary approach not only ensures safe and scalable disposal but also opens opportunities for data-driven public health insights. With your support, we're ready to take this project from prototype to impact.