

24-Hour Innov8athon Hackathon Challenges

Agriculture / Environment – Autonomous Weeder Robot

Problem Overview: Modern agriculture faces soaring demand and shrinking labor. Global crop demand is projected to increase by ~60% by 2050, yet half of farming costs and 55% of farmers face labor shortages. Manual weeding is labor-intensive and relies on harmful herbicides. An autonomous weeder robot could identify and remove weeds autonomously, reducing chemical use and labor costs. Building such a low-cost robot is challenging due to variable crop layouts, complex vision requirements, and power constraints.

Challenge Requirements:

- Design a small mobile robot with sensors (e.g. camera, LiDAR) and actuators to distinguish crops from weeds.
- Implement basic computer-vision or machine-learning for on-board weed detection versus plant.
- Include a weed-removal mechanism (mechanical arm or precision sprayer) and a simple control interface (e.g. smartphone or remote).
- Prototype must operate autonomously in a controlled field setup, demonstrating weed identification/removal in real time.

Evaluation Criteria:

- **Effectiveness:** Accuracy in identifying and removing weeds vs crops in prototype tests.
- **Innovation:** Novel sensing or mechanical design for reliable weeding with limited resources.
- **Feasibility:** System must be demonstrably safe, efficient, and buildable within 24h (e.g. using Arduino/Raspberry Pi, off-the-shelf modules).
- **Impact:** Potential of the solution to reduce herbicide use and labor needs in small farms (score by design justification).
- **Ease of Use:** Clarity and usability of the prototype's interface and operation procedure.

Environment / Disaster – Wildfire Early Warning Drone Network

Problem Overview: Wildfires are rapidly growing in frequency and cost. In 2025 the Los Angeles wildfires alone caused an unprecedented **\$61.2 billion** in damages. Climate change makes fires more likely and severe, posing huge threats to communities and ecosystems. Early detection in remote forests remains extremely difficult. A network of low-cost drones or ground sensors that can spot smoke or heat and relay alerts could

dramatically accelerate response. This is difficult due to harsh conditions (smoke, darkness), connectivity constraints, and the need to cover wide areas.

Challenge Requirements:

- Build a prototype sensor/drone unit capable of detecting early fire signs (e.g. smoke, flame, heat) using affordable hardware (e.g. gas sensor, IR camera, flame sensor).
- Create a simple communication link (e.g. radio or Wi-Fi mesh) so multiple units can alert a base station when fire is detected.
- Develop a basic controller/app that shows real-time status of sensors/drones on a map.
- Demonstrate the system by simulating a fire (e.g. small flame or heated object) and show detection alerts being transmitted.

Evaluation Criteria:

- **Sensitivity & Speed:** How quickly and reliably the system detects simulated fire indicators.
- **Coverage & Networking:** Demonstrated ability to link multiple units and map their data; robustness of communication.
- **Technical Complexity:** Innovative use of sensors and communication tech given 24h constraints.
- **Practicality:** Battery life considerations, ease of deployment (weight, portability of a unit), and safety of design.
- **Impact:** Potential to reduce wildfire response time and damage (based on coverage models or prototype scale).

Healthcare – Portable Multi-Parameter Health Monitor

Problem Overview: Many rural and low-resource clinics lack advanced diagnostic tools. Patients often travel long distances for basic check-ups. Telehealth can bridge this gap by **reducing travel burdens** for rural patients. A portable kit that measures vital signs (heart rate, blood oxygen, blood pressure, temperature, etc.) and transmits results to doctors could enable timely diagnosis. The challenge is making it affordable, easy-to-use, and reliable off-grid. Integrating multiple sensors, ensuring data accuracy, and providing some means of connectivity (e.g. Bluetooth or SMS) are key difficulties.

Challenge Requirements:

- Assemble a compact prototype device with at least three vital-sign sensors (e.g. heart/pulse, SpO₂, blood pressure, temperature). Use microcontrollers (e.g. Arduino, ESP32) and compatible modules.
- Ensure the device has a simple user interface (LCD or smartphone app) to display readings.
- Include data logging or wireless transmission (e.g. send readings via Bluetooth/GSM)

to a phone or server).

- Package all components for portability (portable battery power, durable casing) and demonstrate acquiring vitals from a volunteer or simulator.

Evaluation Criteria:

- **Accuracy:** Sensor readings should be reasonably close to commercial devices for vitals tested.

- **Integration:** Successful multi-sensor integration (reads all parameters sequentially or simultaneously).

- **Innovation:** Creative solutions for low-cost/high-accuracy sensing, power management or offline data storage.

- **Usability:** Device ergonomics, ease of setup and use by non-technical users (clear interface).

- **Health Impact:** Potential of the monitor to improve remote diagnoses (evaluated via scenario description).

Safety / Defense – Smart Safety Helmet for Industrial Workers

Problem Overview: Industrial and construction work is extremely hazardous – these industries “consistently rank as some of the most dangerous” for workers. New wearable technologies (smart vests, helmet sensors) can warn of dangers like worker fatigue or nearby hazards. We challenge teams to prototype a **smart safety helmet** that monitors worker health or surroundings. For example, it could track vital signs (e.g. heart rate, body temperature) to detect fatigue/stress, or use proximity sensors to avoid collisions. Key difficulties include robust sensor mounting on a helmet, real-time alerts, and low false alarms.

Problem Overview: Helmets with embedded sensors are an emerging solution in safety tech[7]. A smart helmet might monitor the wearer’s pulse/EEG for fatigue, sound alarms if dangerous conditions are detected, or even have cameras to alert others of hazards. Building such a system in 24h is hard due to power, miniaturization, and ensuring it doesn’t impede the user.

Challenge Requirements:

- Integrate at least two sensors on a helmet prototype (e.g. heart-rate sensor, accelerometer/gyroscope, gas detector, proximity rangefinder).

- Develop a microcontroller-based circuit (e.g. Arduino) to read sensors and trigger alerts (audio buzzer or LED signal) upon detecting predefined thresholds (e.g. high temperature, sudden fall, obstacle proximity).

- Include a simple data display or wireless alert (e.g. send alert to a phone app) to notify supervisors.

- The prototype helmet must be wearable-safe (secure mounting) and demonstrate detection of one test hazard (e.g. detect a nearby object or simulate worker overheating).

Evaluation Criteria:

- **Reliability:** How consistently the helmet detects and alerts on the chosen hazard(s) with minimal false positives.
- **Functionality:** Number and novelty of sensing features (e.g. vital signs, motion, gas).
- **Wearability:** Safety and comfort of the prototype design, power source choice (lightweight battery).
- **Innovation:** Clever use of sensors/algorithms to address real safety risks in industry.
- **Impact:** Degree to which the helmet could reduce injuries or improve worker monitoring (rated by intended use-case effectiveness).

Healthcare – AI-Powered Mental Health Early-Warning System

Problem Overview: Mental health disorders affect nearly **970 million people globally**, yet many cases go undetected until crisis. Anxiety and depression are among the most common. Early intervention can save lives, but stigma and lack of resources impede care. An AI-driven solution (e.g. a chat interface or wearable analysis) that screens for warning signs (changes in speech patterns, mood, activity) could prompt timely help. Challenges include ensuring privacy, building accurate models from limited data, and creating an empathetic user experience.

Challenge Requirements:

- Develop a software prototype (mobile/web app or chatbot) that interacts with users and analyzes text or sensor input (e.g. questionnaire responses, voice tone) for mental health risk indicators.
- Utilize available ML/NLP tools to process input (e.g. sentiment analysis on chat logs, keyword spotting).
- Implement a basic alert or feedback mechanism: if risk is detected, provide resources or notify a hypothetical counselor.
- Create a simple UI demonstrating a mock conversation or monitoring dashboard.

Evaluation Criteria:

- **Accuracy & Sensitivity:** Ability of the prototype to correctly flag simulated mental stress cases versus normal usage.
- **User Engagement:** Clarity and empathy of the interface in encouraging honest input (rated by judges).
- **Privacy Consideration:** Thoughtfulness in handling personal data (even in concept – judges note if privacy is addressed).
- **Innovation:** Novel sources of data or algorithms used (e.g. combining text and sensor

data, creative UI).

- **Social Impact:** Potential to improve access to mental health care, based on a brief impact pitch.

Education – AI-Adaptive Learning Companion

Problem Overview: Education gaps persist worldwide: ~272 million children are out of school. Those in school often receive one-size-fits-all teaching, leaving many behind. An AI-driven learning app could personalize lessons to each student’s pace and style (quizzes, flashcards, hints), making education more engaging and effective in low-resource settings. Building this in 24h means focusing on a narrow subject (e.g. math or language basics) and demonstrating adaptivity. The challenge is designing a convincing adaptive algorithm and user-friendly content in a short time.

Challenge Requirements:

- Create a simple software prototype (website or mobile app) that delivers practice questions or learning modules in a subject (e.g. arithmetic, reading comprehension).
- Include an adaptive element: for example, change difficulty based on user answers, give hints after mistakes, or track progress.
- Use any AI/ML libraries or rule-based logic to adjust content or provide feedback.
- Prepare a small content dataset (10–20 questions) and simulate one or two student interactions through the system.

Evaluation Criteria:

- **Personalization:** Effectiveness of the adaptive logic (e.g. correctly adjusts to “struggling” vs “fast” learners in the demo).
- **Usability:** Clarity of the UI for a young student (simple interface, clear instructions).
- **Content Quality:** Relevance and correctness of educational content used.
- **Innovation:** Creative use of AI or algorithms for tailoring learning (even simple if properly implemented).
- **Impact:** Judges assess whether this approach could realistically improve learning outcomes in underserved schools.

Transport / Environment – Smart Multi-Modal Trip Planner

Problem Overview: Urban transportation heavily impacts public health: traffic pollution causes ~4.2 million premature deaths annually, and road crashes kill ~1.35 million people every year. Congestion wastes time and increases emissions. We challenge teams to build a software solution that plans “smart” routes by combining walking, cycling, and public transit to minimize travel time, cost, and pollution exposure. A prototype could use open map data (e.g. Google Maps API, OpenStreetMap) to suggest alternative routes. The difficulty lies in multi-modal integration and real-time data.

Challenge Requirements:

- Implement a web or mobile prototype that lets a user enter origin and destination.
- Use at least two transportation modes in route planning (e.g. driving + transit, or walking + bus).
- Integrate any available data (e.g. traffic congestion, transit schedules) to evaluate options.
- Present route options with estimated time and a “score” (e.g. lowest emissions, least travel time). A simple dashboard or map display should illustrate choices.

Evaluation Criteria:

- **Technical Integration:** Success in calling map/transport APIs and combining modes in one itinerary.
- **Clarity:** How clearly the app presents route options and trade-offs to the user.
- **Efficiency:** Whether the chosen “optimal” route in the demo is reasonable (judges may compare manually).
- **Innovation:** Any additional features (e.g. carbon footprint estimate, real-time alerts) beyond basic routing.
- **Impact:** Potential to reduce traffic congestion and pollution (argued via route-savings example).

Environment / Social – Gamified Recycling App

Problem Overview: Plastic and waste are crippling the environment: only ~9% of all plastic ever made is recycled. The rest pollutes oceans and land. Changing public habits is key. We ask teams to create a software solution (mobile/web) that gamifies recycling to encourage behavior change. For example, users could log items recycled, earn points or rewards, and see community leaderboards. The main challenge is designing an engaging game mechanic tied to real-world actions (ideally verified via photo or QR scan) within a short timeframe.

Challenge Requirements:

- Develop a prototype app or web dashboard where users can register and log recycling activities (e.g. scanning a barcode/QR or entering items).
- Implement a simple game element: points, badges or levels awarded for recycling actions. Include at least one visual element (profile, progress bar).
- Optionally, integrate a mock API or database of recyclable items to validate entries.
- Demonstrate the flow: show a user logging a recycled item, earning rewards, and viewing leaderboards or stats.

Evaluation Criteria:

- **Engagement:** Creativity of the gamification concept (points, social sharing, competitions).

- **Functionality:** Working demo of logging/reward mechanics (even with dummy data).
- **Design:** User interface appeal and ease of use for a non-technical user.
- **Impact:** Effectiveness of the approach in promoting recycling (judged by how well game elements motivate repeated use).
- **Innovation:** Any novel feature (e.g. connecting to local recycling bins, local business rewards) beyond the core requirements.

Open Innovation (Wildcard) – Community Upcycling & Reuse Platform

Problem Overview: The above problems cover specific domains, but innovation can come from *any* direction. As a wildcard, teams are invited to tackle an unsolved challenge of their choice that combines technology with societal benefit. A promising area is the **circular economy** – only ~9% of plastic is recycled, and vast waste streams remain underutilized. For example, teams might design a local platform that connects waste producers (households, farms) with upcycling entrepreneurs, or prototype a device that converts waste into something useful. The main goal is **social or environmental impact**. This freedom allows cross-disciplinary creativity, but prototypes should remain feasible in 24h.

Challenge Requirements:

- Define a clear problem statement (e.g. “reducing plastic waste in a community” or “enabling small-scale recycling businesses”).
- Build any prototype (software, hardware or combo) that addresses this problem. For instance: a marketplace app for waste exchange, an IoT sensor for tracking recycled material, or a small “waste-to-product” demonstrator.
- The solution must include at least one concrete technology component (code, circuit, etc.) and a sketch of how it solves the problem.
- Demonstrate the prototype with a use-case scenario (e.g. user signing up on the app and listing waste material).

Evaluation Criteria:

- **Originality:** Novelty of the idea in the chosen problem area.
- **Feasibility:** Technical soundness of the prototype given constraints (does it plausibly work?).
- **Impact:** Potential social, economic or environmental benefit (rated by how directly the solution addresses the chosen issue).
- **Clarity:** How clearly the team defined the problem and explained their solution in the pitch/demo.
- **Execution:** Quality of the demo (UI/UX, hardware build, data flow) even if only a partial prototype.