

Engineering Challenge 2023

Automata Category: Urban Farming

1. Introduction



This year's theme is "urban farming". Coastal cities are especially vulnerable to rising sea levels, which threaten to submerge entire communities and displace millions of people. Many countries are also struggling to feed their populations as crops fail due to changes in weather patterns and more extreme weather events.

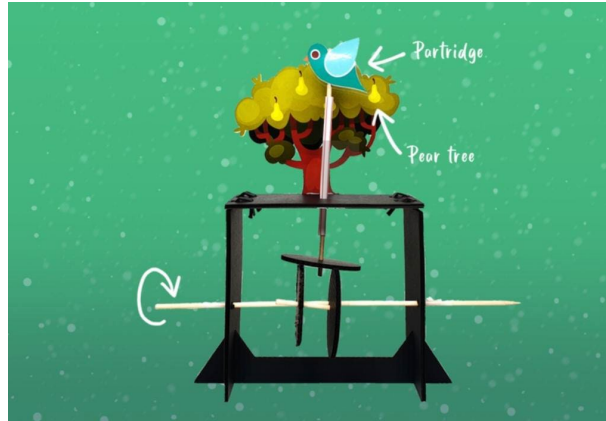
As a result, the need for sustainable and efficient methods of food production has become more pressing than ever before. Urban farming has emerged as a viable solution to this problem, allowing for the cultivation of fresh produce in densely populated areas. With more and more people moving to urban centres, urban farming has become a critical component of the food system, providing locally grown, nutritious produce to urban communities.

In response to the challenges of global warming, many cities have started to invest in urban farming initiatives, creating green spaces, and community gardens throughout the city. These initiatives have not only helped to increase food security but have also brought communities together, fostering a sense of connection and collaboration.

Automata originated from the Cabaret Mechanical Theatre (CMT), a highly acclaimed travelling exhibition originated in the UK that combines the work of Arts, Science and Technology. In this context, it can help ease the process of farming. Desired movements such as plating, watering and harvesting can be achieved using machine parts such as gears, belts and pulleys, ratchets, etc. The concepts and practices used in these automata are especially valuable in the present day and are crucial for what is to come in the future.

With the rise of global warming, countries like Singapore are vulnerable to rising sea levels, which threaten to submerge entire communities and displace millions of people. As a result, the need for sustainable and efficient methods of food production has become more pressing than ever before. Urban farming has emerged as a viable solution to this problem, allowing for the cultivation of fresh produce in densely populated areas.

In this competition, we want students to re-imagine and use mechanical functions to show how they think Singapore can innovate and integrate urban farming in Singapore by designing an urban farm themed toy box.



This Engineering Challenge 2023 is organised by the Singapore Polytechnic's School of Mechanical and Aeronautical Engineering.

2. Competition Rules

- 2.1 The theme of this year's Automata Design Category is "**Urban Farming**".
- 2.2 Participants are required to create Automata using various mechanisms to present what they envision an urban farming system in Singapore will look like in the future.
- 2.3 Participants shall use the appropriate mechanisms, such as gears, cams and linkages, etc. to drive their system on their own, either manually or electrically powered, or both, without much need for human intervention.
- 2.4 The competition is open to all Secondary School students in Singapore.
- 2.5 The number of students in each team should not be more than **five***.
- 2.6 Each individual or team shall submit only one entry.
- 2.7 The size of each Automaton should not exceed **40 cm (Length) x 30 cm (Width) x 30 cm (Height)**.
- 2.8 Participants may design and draw their Automata assemblies and parts manually or using any CAD software. However, the use of CAD software will help them to design, size, dimension and animate their automata movements more effectively before they start to fabricate it.

- 2.9 A Special Award will be presented to the team that can use any CAD Software to design and generate their Automaton with the best virtual animation effect.
- 2.10 Batteries that are acceptable in this challenge are dry-cell alkaline batteries and Alkaline batteries, where each individual battery is not to exceed 9v. The batteries need to be easily replaceable. (see Annex).
- 2.11 Batteries that are not acceptable are Li-ion, Li-Po, power bank, Lead-acid or any form of rechargeable batteries.
- 2.12 Motors to be used: Not to exceed the operating voltage of 12V DC. (see Annex).
- 2.13 The circuitry for the battery-powered motor needs to have an off/on switch. (see Annex).
- 2.14 Any exposed gearing or belt drive needs an encasement for safety reasons.

3. Design Guidelines

- 3.1 Participants should first visit various Automata websites, such as the <http://www.cabaret.co.uk/>, <http://automata.co.uk/> and <https://www.robives.com/mechanism/> websites before embarking on their own design. They should also visit various Design and Technology websites, such as the <http://www.technologystudent.com/> (click "MECHANISMS" and "GEARS AND PULLEYS") to learn how Automata parts can be animated by gears, timing belt and pulley drives, cams, linkage mechanisms, ratchet mechanisms, crank and crank shafts, etc.
- 3.2 Participants are required to build their Automata using materials such as plywood, chipboard, softwood (balsa), wood, ball/ cube/dowel, basswood sheet/strip, ice cream stick, plastic, high-density foam, kapaline board, etc. They can also use 3D Printers and 2D Laser Cutting Machines to create their Automata parts.
- 3.3 Parts may be joined together by adhesive (glue), nails, self-tapping screws or dowels. Pins may be used to create joints. Strings, wires, standard gears, belts and pulleys, etc., can be used to create the movements of the Automata.
- 3.4 Compression, extension and torsion springs of appropriate size and stiffness (about Ø0.5 mm wire diameter) should be connected to cam followers, cranks and linkages, etc. to create the return or oscillating movements of moving Automata parts.
- 3.5 Participants should source for the above-mentioned materials and standard parts before sizing their Automata. These materials and standard parts can be purchased from shops, such as Art Friend, Daiso and hobby shops.

4. Competition Details & Prizes

4.1 The submitted entries will be judged and ranked by a panel of judges formed by the organising committee.

4.2 The prizes are:

1 st Prize	\$500 Cash Voucher + Trophy for School
2 nd Prize	\$350 Cash Voucher + Trophy for School
3 rd Prize	\$200 Cash Voucher + Trophy for School
5 Merit Awards	\$100 Cash Voucher
Design Award	\$100 Cash Voucher

Design Award – the award will be awarded to the team with the best design based on the votes of the organising committee, teachers and representing schools.

Commendation Awards for all deserving entries (\$50 Cash Voucher).

4.3 All participants will be presented with certificates.

5. Judging Criteria

Presentation	25%
Functionality	15%
Model Quality	20%
Originality and Creativity	40%

6. Registration & Final Submission

6.1 Participants are to register their interest to their teacher I/C. The teacher I/C shall collate and submit to the Organising Committee online by clicking on this URL link -> [Registration for Engineering Challenge 2023 | FormSG](#)

6.2 Closing date for competition registration is **26/05/2023**. Email the registration form (found on the above website) to the committee.

6.3 Participants should submit their entries through their teacher I/C to the Organising Committee by **06/09/2023** for set up purpose.

6.4 Each team's submitted entry must include:

- The physical model of the Automaton
- Presentation Materials - must be in **electronic format only**. (This is to avoid printing of paper-based presentation materials.)

6.5 There will be a judging day where each team is required to give a 5 – 10 minutes presentation on their submitted entries to a panel of judges. Details

of the judging day arrangement will be made known to participants separately

- 6.6 All works submitted should be original and should not have been awarded by the organiser of another similar competition before.
- 6.7 All participants are responsible in ensuring their submission will not infringe existing copyright/patent law.
- 6.8 The Organising Committee or sponsor is not liable for infringement or abuse of any design as a result of the entry in this competition or as a result of subsequent publicity.
- 6.9 Entries that do not meet the competition rules will be disqualified.

7. Announcement of Results

- 7.1 The results of the Engineering Challenge will be announced at the Awards Ceremony scheduled on **7th September 2023**. The Award Ceremony details will be made known to participants separately.
- 7.2 In the event of a tie, the organising committee reserves the right to redistribute the prizes.
- 7.3 All decisions made by the judging panel are final.

For more information and registration, please contact:

Sustainability Competition (Automata) Leader:

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Annex:

Pictures of acceptable batteries



Typical 12V DC motor



Typical On/off Switch

