



Supplementary Rules – Junior and Senior Secondary Groups

Operational function of the device: Able to stop at the specified position.

Materials: Materials are not limited except for ready-made devices.

Specifications:

1. Size:
 - a. The device should be composed of two parts: “Moving part” and “Controlling part” .
 1. “Moving part” is the part of the device for moving.
 2. “Controlling part” is the part of the device for controlling the “Moving part” .
 - b. The size of the device should not exceed $29.7cm \times 21cm$ (same as A4 size) .
2. Restriction on “Controlling part” : The IC555 must be used in the controlling part for time control. Participants cannot use processors or other similar types of IC. A complete electric circuit diagram should be submitted together with the device.
 - a. **After registration, Junior Secondary participants can get two complete sets of controlling parts for use or reference:**
 - b. **After registration, Senior Secondary participants can get two packs of components for the controlling part for use or reference.**
3. Restriction on “Device” : DC motor must be used for driving the device.
4. Restriction on source of power: The device should be driven by battery. The quantity used is limited to a maximum of eight AA batteries at one time.

Sequence of competition: The sequence of competition for each team will be determined by sortition.

Format of competition: Each team can do a maximum of eight trials, among which the results of three trials will be used for score calculation.

Competition ground: The competition ground includes the starting/end points and the race track. See **Figure 1**.

Flow of competition:

1. Before the competition, all team members should stand by at the “stand-by zone” . The designated team leader will be the decision maker during the competition.
2. At the start of the competition, the team leader should follow instruction of the staff to mark a “measuring point” on the edge of the device for distance measurement during the competition.
3. The team leader will draw three times to determine three different distances for the “destination point” of the competition and the staff will mark these points on the “race track” .
4. After determining the distance, the team members should place the device on the “starting point” . During the competition, the team members should remain in the “stand-by zone” .
5. The staff will signify the start of the competition. During the competition, team members are not allowed to touch the device without consent of the staff or it will be considered as violation of rules.
6. After the competition has begun, the device should move from the “starting point” for its first “trial” . When the device comes to stop, the trial is considered to be finished.



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7. After confirming with the team leader, the staff will measure the distance between the “measuring point” and the “destination point” .
8. The team leader **has to decide on the spot** whether to count the result of that “trial” in the score calculation. He/she will also decide whether to use the distance from the destination point of that “trial” for comparison. After acknowledgement and registration, the results cannot be changed.
9. After the acknowledgement by the team leader, the staff will arrange the team members to place the device at the “starting point” again for the second trial. The procedure will repeat until the result of three trials are recorded, or a maximum of eight trials are completed.
10. After the competition, the staff will calculate the total scores based on the three recorded trial results.
11. The competition time is **10 minutes** (excluding the time for measurement by the staff). If the team fails to complete the competition within the time limit, or if less than three results can be recorded after eight trials, the missing results will be recorded using **the total length of the race track** which is **1300cm**.

Race track: Each race track is a straight surface of approximately **30cm** wide and **1300cm** long. For the Junior Secondary group, the race track is set up with fences of a maximum height of **6 cm**. For the Senior Secondary group, only lines will be drawn on both sides of the race tracks. On one end of the race track, a horizontal line will be marked as the “starting point” . A “perpendicular bisector” will be drawn from the starting point to the other end of the race track. See **Figure 1**.

Calculation of scores: The score is calculated based on the distance of the device from the “destination point” after it has come to a stop. Each team can do a maximum of eight trials and the team leader will select the results of three trials for score calculation. The shortest straight line distance between the “destination point” on the race track and the “measuring point” of the device is measured as the result of the trial (**0.1cm** precision). After adding up the distances of the three selected trials, the team with the shortest distance will win. If the scores are the same, the team with a lighter device will win.

Definition of “destination point” and “measuring point” :

1. The “destination point” is located on the perpendicular bisector of the “race track” . There are three destination points in the competition. The distance from the “starting point” to each “destination point” is drawn by the team leader before the competition. After the drawing, the staff will measure from the starting point along the perpendicular bisector with the drawn distance to mark the destination point.
2. The “measuring point” is marked by the team leader on the edge of the device before the competition. That marking should be clearly seen for distance measurement when the device comes to a stop. During the competition, if the marking for the “measuring point” becomes partly damaged or unable to be used for measurement due to any reason, the result for that trial will be recorded using **the total length of the race track** which is **1300cm**.



Scoring Method for Senior Secondary Group:

1. *Bonus scores for weights:* Seven weights will be distributed to each team in the competition (total eight trials). Each weight can be used for once only, in cylindrical shape, weighing around 100g, and of height 4cm and diameter 2.3cm. Each team should consider their allocation and the number of weights on the device in each “trial”. They are not allowed to use any kind of glue or destructive method to fix the weights onto the device. After the competition, if the weights are still properly located on the device, the bonus scores for the weights in that trial will be calculated as follows:

$$\alpha = \frac{X}{Y} \quad [X \text{ is the result of the trial, } Y \text{ is the number of weights put on the device, } \alpha \text{ is the calculated result after taking into account the number of weights used, rounding off to } 0.01\text{cm}]$$

[Y] only counts the number of weights that are still on the device after the trial. If the weights fall off during the trial, the result of that trial will still be counted, but the number of weights fallen off will not be counted. If no weight is used in that trial, [Y] will be calculated as 1.

After each trial, regardless of whether the result of that trial will be used for score calculation or not, the weight(s) used in that trial will be taken away by the staff and it cannot be used again in the subsequent trial(s).

2. *Bonus score for controlling part:* If a general purpose circuit board (non-printed circuit board) or breadboard is used to build electric circuits for controlling part, bonus score will be rewarded by **multiplying the trial result with 0.9**, as follows:

$$\beta = 0.9 \times \alpha \quad [\alpha \text{ is the result taking into account of the weights; } \beta \text{ is the result after calculating the bonus score for the controlling parts, rounding off to } 0.01\text{cm}]$$

3. *Penalty for unused weights:* The participating teams should use all the weights during the competition. If any weights are unused after the competition, the penalty on the result will be calculated as follows:

$$\text{Final result} = \left(1 + \frac{Z}{10} \right) \times \text{Trial result} \quad [Z \text{ is the number of weights unused, Trial result is the sum of the selected trial results, rounding off to } 0.01\text{cm}]$$

Maintenance:

The participants can perform maintenance work on the device (including changing of parts and batteries) during the competition. While the repair work is in progress, the competition time will continue to be counted. The number of trials (including the “trial” that was in progress plus its result before the maintenance) will still be counted. If any repair work is required during the competition, the participants should notify the staff concerned before they can enter the competition ground to get their device and perform the maintenance. After the maintenance work is finished, the participants have to reset their device at the “starting point” of the competition ground.



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Violation of rules:

The penalty for violation of rules in the following situations will depend on their seriousness. The team may be disqualified for the competition in serious situations.

1. The device causes damage to the race track in any way during the competition;
2. The participants touch the device during the competition without notifying the staff;
3. The dimensions of the device do not follow the specifications listed in the rules and regulations;
4. The participants use devices that have not been inspected by the Organizer of the competition;
5. Without permission from the staff, the participants enter the restricted area of competition ground during the competition.
6. The participants do not follow the instruction of the staff during the competition;
7. The participants do not use IC555 in the “Controlling part” .
8. After the commencement of the competition, team member(s) do(es) any actions that may facilitate the operation of the device (e.g. using remote controls to stop the device).

Others:

1. All participants should pay attention to electrical safety.
2. Please bring your own tools. No tools will be provided by the Organizer.
3. All participants are welcome to use the testing ground in the Museum during opening hours before the competition.

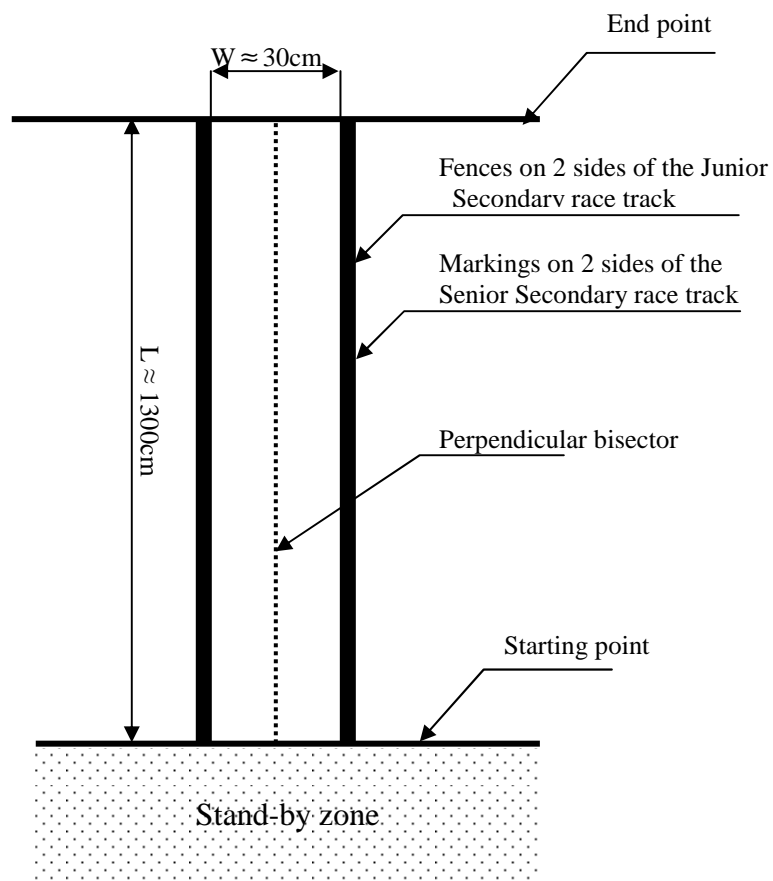


Figure1-Competition ground



Supplementary Information:

Introduction of 555 Timer

555 timer is a common type of integrated circuit. When connected with a resistor R and a capacitor C , it will become a simple timer switch circuit. The value of the timer is approximately $t \approx 1.1RC$. It has numerous applications. For example, it can be used to switch off the light of a staircase automatically after a set period of time. It can also be used to control the DC motor to run for a certain period of time. (Figure 4 - Circuit diagram)

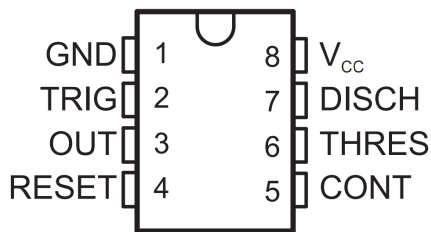


Figure 2 - Pin Diagram of IC555

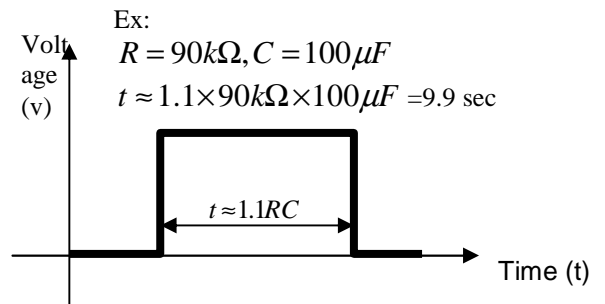


Figure 3 - Voltage Diagram

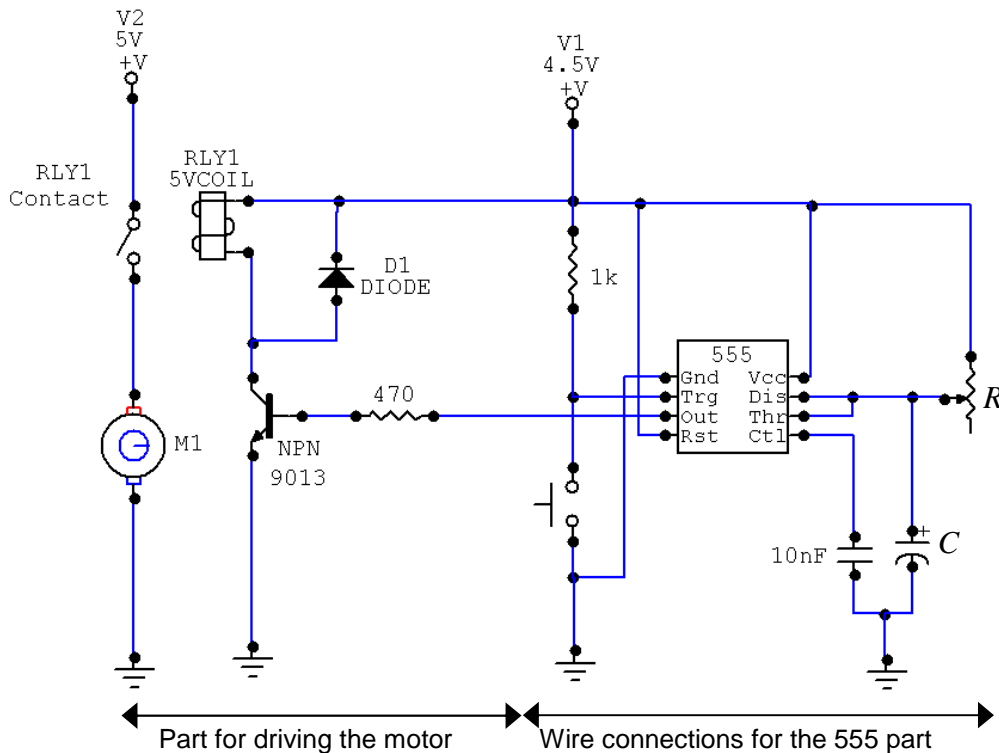


Figure 4 - Circuit diagram of a DC circuit whereby the operation time can be set