

Project Assignment B [12 marks]

Title:

Testing station operation

Brief:

The availability of an automated testing station for reagents will allow operators to confirm if reagents are correctly prepared. The station is meant to be fulfil the following operating sequences:

Positive sequence

1. The plastic beaker containing a drop of food dye is placed on the station platform.
2. The gripper picks up the plastic beaker to be placed on a designed workstation.
3. A specific amount of water is delivered by pump to the plastic beaker, which is confirmed via weight (via the load cell incorporated in the workstation).
4. The gripper platform is moved into position so that pendulum mixing is carried out (using the same unit developed in Project Assignment Part A) using 10 displacements of liquid drag forces applied in one direction.
5. Proper mixing is confirmed using optical readings (via the LED and photosensor incorporated in the workstation).
6. The gripper transfers the plastic beaker to the heater assembly to dwell for 10 seconds.
7. The gripper transfers the plastic beaker back to the original location on the station platform.

Negative sequence

1. The plastic beaker WITHOUT a drop of food dye is placed on the station platform.
2. Steps 2 to 4 in the positive sequence are repeated.
3. No dye is confirmed using optical readings.
4. The gripper transfers the plastic beaker back to the original location on the station platform.

The assessment aspects include

- i. Workstation Design
- ii. Automated Operation
- iii. Human Machine Interfacing

Specifications:

Workstation Design

- Must incorporate usage and operation of the load cell assembly, LED and photosensor (all provided with the kit) WITHIN the platform of the testing station.
- Must incorporate a fixed location for the plastic beaker to be placed using the gripper.
- Must incorporate an inlet nozzle for the tube to be firmly affixed such that liquid from the pump (tube and pump provided with the kit) can be delivered to the plastic beaker WITHOUT spillage.
- Dimensions: The length and width must NOT exceed the specified footprint on the station platform, but there are no restrictions on height.
- Has to be monolithic (single structure).
- Material: PLA or PLA+.

Automated Operation

- Gripper and station platform operation to be done using the application software provided on one laptop.

- The operation of all the other elements are to be done via Matlab program interfacing on another laptop.
- The fine tuning of operations and recording of outcomes are to be completed within the half-hour session organized. Additional sessions needed will result in penalties.

Human Machine Interfacing

- The interfacing must be done using Matlab with minimal keyboard typing input.
- The essential features to be included are:
 - o Status indicators (which operation is being carried out at any point in time)
 - o Timing indicators (allowing the operator to be aware of duration efficiencies)
 - o Alerts (for situations that require operator intervention)
 - o Emergency stoppage of operation
 - o Data logging of volume against time filling is done to allow post operation analysis
- Icons and figures should be preferentially be used over text and numbers where possible.

Submission (as a single .zip file):

This is a team submission with only ONE submission by a representative of the team. The deadline for submission is Week 10 Friday 4/10/2024. The submission MUST include:

Video

- Single .mp4 file that includes footages of:
 - o Important features of the workstation design.
 - o The ability to complete the positive sequence followed by the negative sequence of the automated operation.
 - o Important features of the Human Machine Interface.
- Not exceeding 3 minutes.
- Clear captions are to be included in the video footages.

Documentation

- Single .pdf file
- Not exceeding 2000 words
- Up to 10 figures are permitted
- Clear and concise explanation of the workstation design, automated operation, and Matlab based HMI model using grammatically correct sentences with no spelling errors

Grading criteria:

Awards:

	Poor (0-0.49)	Acceptable (0.5-0.69)	Good (0.6-0.79)	Excellent (0.8-1.0)
(a) Workstation design for liquid handling (required – liquid from the pump is consistently directed only into the beaker; desirable – a nozzle is created that delivers liquid uniformly to the sides instead of directly on to the liquid in the beaker to minimize splashing) [1%]				
(b) Workstation design for dye in liquid detection (required – light source and detector are located such that it maximizes detection sensitivity; desirable – it has the ability to cancel out the effect of any background illumination) [1%]				
(c) Workstation organization (required – the elements are located in the platform such that operation is optimal and all electrical wiring is neatly organized; desirable – features are introduced to eliminate any spillage and potential electricity contact hazards) [1%]				
(f) Creativity (the workstation OR model incorporates innovations that encourage simplification or the ready scaling up to support more demanding or complex schemes in the future) [1%]				
(g) Automated operation of liquid filling (required – once the beaker is in place, liquid filling can be done without any spillage within 10 seconds and within 5% of volume accuracy; desirable - once the beaker is in place, liquid filling can be done without any spillage within 3 seconds and within 1% of volume accuracy) [1%]				
(h) Automated operation overall (the positive and negative sequences can be carried out seamlessly) [1%]				
(i) Human machine interfacing effectiveness (required – the specifications are met and the interface is able to be operated with minimal use of text and numerical entry by the operator; desirable – the organization of the interface is highly intuitive and uncluttered. Data logging is				

easily retrievable by the operator as well as the status of recording throughout the process) [1%]				
(j) Video effectiveness (the video footages recorded are instructive and engaging with good use of captions; they also illustrate the unique features incorporated and achievements of the system when operated) [2%]				
(k) Documentation effectiveness (the workstation design, automated operation, HMI, are described, explained and discussed in an organized, logical and succinct fashion) [3%]				

Penalties:

- (a) Failure to adhere closely to the specifications.
- (b) Grammatical and spelling errors in the documentation.
- (c) Poorly constructed and difficult to understand sentences in the documentation.
- (d) Hand drawn sketches and unclear images used as figures in the documentation.