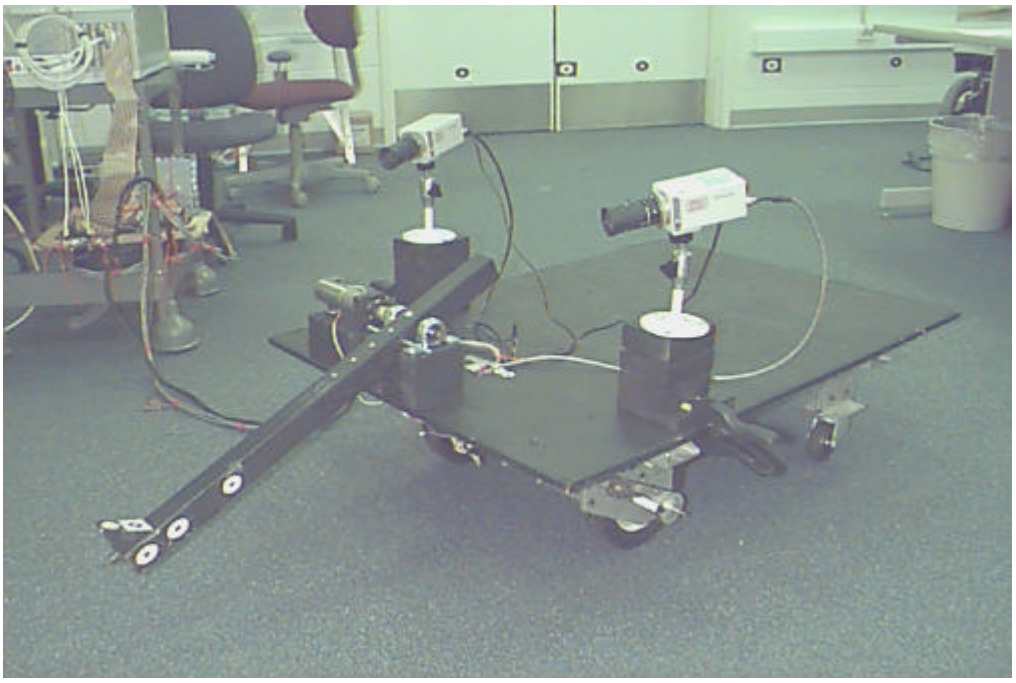
REQUEST FOR PROPOSALS

FLEXIBLE ASSEMBLY WORKCELL - FAW

OPPORTUNITY

AME470 Inc. has recently embarked upon the development of a new flexible assembly workcell (FAW) for the automated assembly of car door windows for Phisher Prize Inc. Phisher Prize is a leading manufacturer of children's toys. Recent success in AME470's Automated Assembly Division has attracted Phisher Prize as a potential customer for the development of a new flexible assembly workcell. Phisher Prize has a need to batch process a variety of door/window combinations in the same flexible assembly workcell in order to be able to rapidly respond to changing market demands. In the past this batch processing was performed manually. Phisher Prize believes that if the batch processing operation could be automated, they would achieve improved efficiency and reliability at reduced costs. In order to make such a system available to Phisher Prize, it is desirable to explore the potential of developing a low-cost, fully-automated flexible assembly workcell which can provide this capability. Along with the development of the necessary technology, it is imperative that its efficient implementation be in a form suitable for easy operation and inexpensive maintenance.

This flexible assembly workcell development project will involve three phases of engineering for each design team; 1. concept definition, 2. concept engineering design study and documentation, and 3. prototype fabrication. AME470 management has decided that a new **vision based mobile robot (VBMR)** developed by AME474 Inc. will be incorporated in the flexible assembly workcell.



Vision Based Mobile Robot (VBMR)

The flexible assembly workcell will include a **door positioning station (DPS)**, which will automatically retrieve doors from an incoming queue and position each door model for

adhesive application and then transfer the door to an outgoing que for window assembly. After positioning the door for assembly, the DPS will signal the **VBMR** to initiate the docking of the **automated adhesive applicator (AAA)** with the DPS. Once docked, the AAA must be able to apply adhesive (simulated by a Sharpie marker) in a continuous motion tracing a path 0.25" outboard of the window frame. After adhesive application the VBMR undocks the AAA and returns to an at-rest position.

AME470 management has allocated resources for the development of two AAA "proof of concept prototypes" and three DPS "proof of concept prototypes". In addition resources have been allocated for augmenting the AME474-VBMR to interface with the two AAA and three DPS prototypes. A demonstration of the proposed concepts to Phisher Prize using the "proof-of-concept" prototypes will be part of this development project.

PROJECT REQUIREMENTS: Each design team will:

1. Develop a design for either the DPS, AAA or the augmented VBMR and document the design in the form of a detailed engineering design proposal. AME470 management will assign design teams to work on one of the three efforts (i.e., DPS, AAA or VBMR). The greatest measure of merit will be associated with meeting all project scheduling and cost goals and demonstrating a robust design. The design must be based upon sound engineering analysis and simulation of the system component's performance and its operation are critical components of the design proposal. The results of this project must be presented in a Critical Design Review and the performance of the prototype presented at a Summary Presentation at the completion of the project.
2. Fabricate a "proof-of-concept" prototype for the system described by the proposal. The prototype must be capable of demonstrating the fully autonomous operation. The prototype will also be used to demonstrate the durability, reparability, and portability of the proposed design.
3. Develop a validation test plan and be prepared to demonstrate the operation of the prototype of the FAW on or about April 29, 2000.
4. Follow established procedures for collecting and reporting time spent on the project and cost accounting records for the entire project.

SPECIAL CONSIDERATIONS AND SYSTEM PERFORMANCE REQUIREMENTS:

1. The DPS system must be powered by "on-board" energy sources (batteries).
2. The DPS must be able to retrieve three different door models from a queue, identify which door model has been retrieved, and position the door for adhesive application. The DPS team is responsible for designing and fabricating the in-coming Que. The queue design should allow for a random ordering of the in-coming doors.
3. The door must be restrained in its assembly position so that the AAA does not move the door during adhesive application.
4. The DPS should position the doors so that all three AAA units can dock and apply adhesive without interfering with the DPS. The AAA teams will provide a common set of target requirements and target specifications for docking.

5. The DPS should be capable of processing 2 doors per minute. Note that only half of this time will be available for loading and unloading each door. A cumulative of 15 seconds will be required for VBMR positioning and AAA adhesive application.
6. The DPS must be able to signal the VBMR that a door has been positioned and restrained.
7. The DPS must be able to communicate which door model has been positioned to the VBMR/AAA system.
8. The DPS must provide visual docking targets that the VBMR can use to dock the AAA with the DPS. The VBMR design team will provide requirements for visual queuing during docking.
9. The DPS must be able to position each door in a single fixed plane and orientation.
10. The AAA must meet weight and volume constraints imposed/negotiated by the VBMR team.
11. The VBMR design team will develop system performance requirements for the AAA with respect to VBMR interfaces.
12. The AAA system must be completely portable and powered by VBMR mounted energy sources (batteries). Battery mounting and power supply wiring interfaces will be the responsibility of the AAA group. The VBMR group must define mounting location requirements.
13. The AAA must be able to apply adhesive (simulated by a Sharpie marker) in a continuous motion tracing a path 0.25" outboard of the window frame.
14. The start and stop location of adhesive application should overlap by 0.25" to insure a complete seal.
15. The AAA will signal the VBMR that adhesive application is complete.
16. The VBMR will undock the AAA and return to an at rest position.
17. After the VBMR undocks the AAA, the DPS transfers the door to an outgoing queue for window assembly. The DPS team is responsible for designing and fabricating the out-going Que. The outgoing door transfer and queue should not contact adhesive application area on the door.
18. The DPS system must be fully contained within a 3 ft (wide) x 2ft (deep) x 2-ft. (high) volume. Doors will be positioned such that the VBMR/AAA system will approach the DPS on its "front face". Incoming doors will feed in from the left and exit to the right as one faces the DPS.
19. The DPS should weigh less than 15 lbs. Minimization of the number of parts used in the DPS or AAA has been deemed a critical priority by management.
20. The individual design group will define target product specifications. Consideration should be given to cost, reliability of the system, accessibility and ease of maintenance and energy consumption. Special attention should focus on the interface performance requirements and target specifications (i.e., DPS/AAA, DPS/VBMR and AAA/VBMR).
21. All electronic components (i.e. motors, servos, computers, wiring, circuit boards, etc.) must be able to be removed from either the DPS or AAA and reinstalled into the prototype system in 20 minutes by two people with manual hand tools only.
22. Since environmental impact is an issue in all product development, the "recycle-ability" of the systems (i.e., DPS, AAA, VBMR), and the nature of all the proposed fabrication processes will be strongly considered in the product assessment.