AATOF Engineering
Safety Analysis for Robot Design

AATOF DFMEA Assessment for Robotic Assembly Component Failures						
Component or Subsystem	**Mode of Failure**	**Symptom**	**Effect**	**Probability (A-E)**	**Severity (I-IV)**	**Risk Index**
Motor	Overheating	System no longer rotates the assembly	Windings and insulation may fail or catch fire	E	I	(I-E)
Lazy Susan	Bearing surfaces seize	Assembly seized and no longer allows rotation	May cause motor to burn out trying to rotate immobile object	D	I	(I-D)
Camera	Internal chip fails	No output to program of game board	Robot is left without the ability to detect the game board	E	III	(III-E)
	Filtering system malfunction	Camera is unable to distinguish between colors	Robot can detect relative light absorption, but not the colors of the washers	E	III	(III-E)
Electromagnet	Wire breaks	System is unable to pick up and rearrange washers	Assembly will not have ability to rearrange washers	D	II	(II-D)
Power Supply	Short Circuit	Outputs connected, excessive current produced	Damage to power supply or motor	C	I	(I-C)
Power supply	Wire insulation failure	Bare conductor exposed to external people and objects	Shock hazard to personnel	B	III	(III-B)
Data transmission connection	System produces erroneous signal or had unintended feedback	Robot behaves in unexpected and undesirable manner(s)	Failure to complete rearrangement, potential motor overspeed issue	B	IV	(IV-B)

Electromagnet suspension	Electromagnet is not sufficiently supported or maintained in position	Assembly to support electromagnet drops magnet or magnet is misaligned	Potential damage to gameboard or electromagnet	D	II	(II-D)
Camera suspension	Camera does not point at game board or falls	Camera cannot be focused on game board or falls without outside intervention	Potential damage to camera/ inability of camera to detect game board and washers	C	II	(II-C)

Likelihood/ Impact	Very Probable (A)	Probable (B)	Occasional (C)	Remote (D)	Improbable (E)
Catastrophic (I)			•	•	•
Critical (II)			•	••	
Marginal (III)		•			••
Negligible (IV)		•			

It was determined by the analysis methods outlined above that the primary hazards were to the equipment itself due to improper handling, and to the user through shock potential. In order to minimize the potential to damage the equipment needed for this robot to work, the intended design for construction incorporates the use of reinforcing supports and geometrically favorable structures to reduce the possibility of failure. Sufficient fasteners and adhesives were used to further ensure the sound attachment of all base components. While not implemented at this stage due to the requirements of the subproject, the final design incorporates the use of a vertical support for the camera as well as for the electromagnet. A balanced construction is intended to reduce the instability of the robot and its housing once these additional elements are incorporated.

The primary hazard to the user is that of shock due to improper grounding or shorted wires. In order to mitigate these potential concerns all external components of the assembly are made of wood, as wood is an insulator and does not allow for the buildup of charge or the transmission of current. The metallic or electronic components with which the user may interface will be grounded and as isolated by wood from other components as is possible given the construction parameters in order to fully mitigate the risk to the user posed by the system.