Design Solutions:

1. The first proposed design combines the photosensor and the electromagnet on the end of a fixed distance arm. The electromagnet and photosensor are raised a minimal distance from the surface of the game board; ideally just enough for the washer to clear the board. This is so that the arm does not need to bend to enable the electromagnet and photosensor to get close enough to pick up the washer, as this would complicate the mechanics of this system greatly. The arm would be of acrylic and be light enough to not require additional support beyond that provided by the motor's shaft. The motor would be attached to the game board via angle brackets - depending on the motor housing this may be a part that would best be 3-D printed to hold the motor. The game board would be slightly elevated. This would allow for the power for the motor/electromagnet, as well as the outputs from the photosensor, to be directed through the center of the board so that the wires do not detract from the aesthetics of the game. In this iteration, the photosensor would determine the color of the washer, if present, and the algorithm would determine if the washer is in the correct position or if it needs to be moved. Before placing a washer, the photosensor would need to determine if the spot is already occupied by another washer. If so, an alternate location to put the washer for an intermediary step would be used.

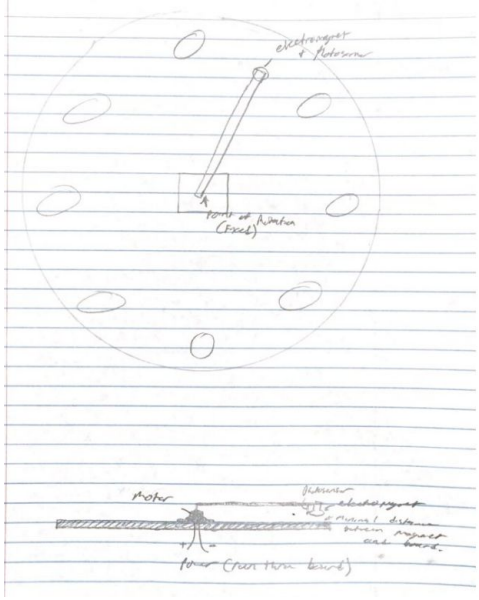

Figure 1: Fixed Distance Arm

2. For the second design idea, a similar approach to the first one was taken. However, this rendition makes use of an arm that was two sided, extending over two holes simultaneously. As such, the photosensor and the electromagnet are on opposite sides of the board at all times. This necessitates more memory for the system and potentially more movement as a full 180 degrees of travel must be completed prior to the magnet being over a known washer. A decided benefit would be the balance of the system due to the reduction in bending on the motor shaft, which should serve to increase long-term reliability of the system. This system would also ensure that the photosensor can be centered over the washer as can the magnet, as the two are not in direct competition for the space.

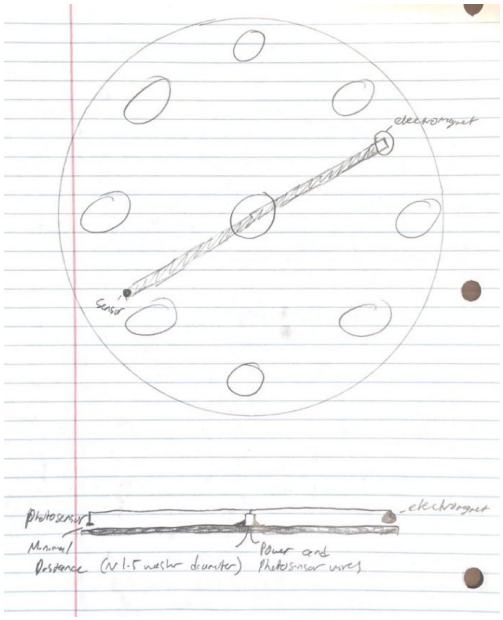

Figure 2: Two-Sided Arm

3. The final concept evaluated was that of a stationary photosensor and electromagnet and a rotating game board. This would reduce the difficulty of routing wires and the ensuing entanglement when rotation happened as all electrical components would be fixed. Difficulty would arise from the need to mount the game board on the shaft of the motor; it also would require the motor to move a substantially greater amount of weight. Further concern would be the balance of the system, especially once washers were congregated to one side of the board, if that were to happen in the course of arrangement. A lazy susan is the type of implementation envisioned below.

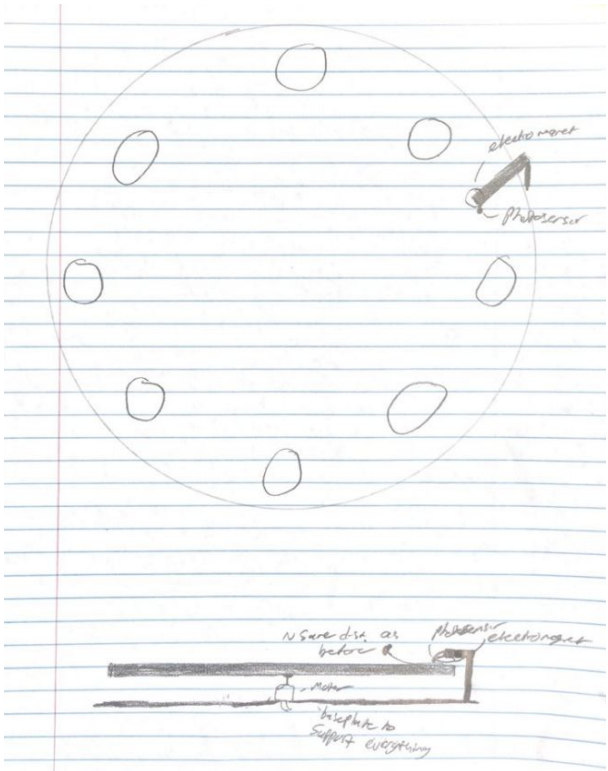

Figure 3: Lazy Susan

Concept Evaluation:

Table 2: Weighted Decision Matrix

		Designs (1-3)		
Criteria	Weights	1	2	3
Ease of Implementation	3	3	1	3
Enables Simple Algorithm to be Used	1	3	1	3
Low Cost	3	3	3	5
Motor Stress (Reliability concerns)	5	3	5	1
Wire Routing	3	1	1	5
Portability	1	3	1	3
TOTAL SCORE		42	42	50

Specific criteria pertaining to the construction of the project and the importance of these criteria to the team members are defined in the above table. Based on the weighted evaluation performed above and the project visualizations vocalized by team members, AATOF decided that option 3, the use of a fixed camera and photosensor with a rotating game board was the design best suited for the project. Without access to the game board and washers, a mockup was made using cardboard to provide a visual aid in understanding the system design as intended by AATOF.

Figure 4: Robot Mockup