1106 Design Project Deliverable D

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Introduction

We've decided to divide our system into three subsystems. The first subsystem is the loading system, which is responsible for loading the boards into cleaning system. The next subsystem is the cleaning system, which is responsible for cleaning the boards. The final system is the Drying/Storing system, which is responsible for collecting the boards from the cleaning system. We decided to divide it into these three subsections because it allowed us to simplify the overall design while allowing the cleaning system to remain as a single subsection. This allowed us to consider a wide variety of cleaning designs, without them having to be compatible with other subsections. The other two sections were chosen because they are needed for the system to be automated, while not being part of the cleaning system.

Loading system

We considered three ideas for the loading system. The first system we considered was a dispenser system, which would automatically load the boards into the cleaning system. The second system we considered was a manual loading system, which would involve the user loading the boards into the cleaning system. The last system we considered was a ceiling mounted system, which would require the user to load the boards into a ceiling conveyer mechanism, which would then be pushed through the device.

The first concept we considered was a dispenser system. This was my, Jacob's, idea. This system is inspired by a pallet dispenser and would allow the user to insert a stack of boards on the one side, and them to be pushed out one by one. The way that this would work is by having a box in which the boards would be inserted, which would be surrounded by walls on all four sides, and a belt underneath the stack of boards attached to paddles. These paddles would be only tall enough to push one board at a time, and the walls around the system would stop other boards from following. The advantages of this system are it involves almost no work by the user, and it allows the user to stay a safe distance away while the machine is actually operating. The disadvantages are that it increases complexity as it would require a motor to move the belt.

The second concept we considered was for the users to manually insert the boards into the system. This was Mackenzie's idea. The advantages to this are that it would reduce both cost and complexity, which would make the overall system more reliable. This would come at the cost of it still requiring labour and reduced safety as the user would be required to work near the machine as it is running.

The final concept we considered was a ceiling mounted system. This was Randina's idea. This system would consist of ceiling mounted rails, which would have devices that connect the boards to the rails allowing them to be moved along through the system. The advantages of this system are that it would only have a small amount of labour, the user would only be required to attach the boards to the rails, and that we would have a high level of control over where the boards are at any point. It would also have the same advantages as our first concept with the user not being near the system as it is running. The disadvantages are that the system is complex and would be expensive to implement.

We decided that the best system is our first concept. We first illuminated our second concept because in favour of automation. We made this decision because since the main goal of the product is to cut down on labour time, a solution which is automated is significantly better than on that isn't. There is also the safety advantage that comes with the user not needing to be present for the machine to operate. The decision between our first and our final concept was more difficult, however we decided on our first concept due to it being simpler. We were also concerned about the feasibility of creating our final concepts within a reasonable price.

Cleaning system

We considered three separate ideas for cleaning system. The first system we considered was a pressure washing design, which would use pressurized water to clean the boards as the passed through the cleaning system. The second design we considered was a system using brushes, which would use the scraping power of multiple brushes to clean the boards. The final design we considered was an Ultraviolet light design, which would sanitize the boards using ultraviolet light.

The first design we considered was the pressure washing design. This was my, Jacob's, idea. This was inspired by a system to clean Styrofoam boards used at a tree nursery where I worked over the summer. This would consist of high-pressure water being sprayed at the boards from both sides as well as the top and bottom as it passed through our system. The pressurized spray would come from six pressure washing nozzles all connected to pvc pipe which would go around the blocks. This would ensure that all parts of the board got cleaned. The pressurized water would be supplied by a pressure washer. Surrounding the system would be two wall and two flaps, which would allow the boards to pass through the system while retaining as much water as possible. Underneath the system would be a water catching system that would feed the water back into the pressure washer, creating a loop. The user would simply have to fill the system with water at the beginning and drain it after usage. The advantages would be able to automatically clean the boards while being fairly simple and relying primarily on pre-existing off the shelf technology. The disadvantage is that it involves high pressure water which could reduce the safety of the system.

The second design we considered was a system using brushes. This was Randina's idea. This system would involve brushes cleaning all the sides and the holes in the board. This would involve an Arduino to control the brushes so that they were able to line up with the holes in the board and clean all the board. The brushes would come from above and be pushed down and be connected to motors which would allow them to spin and clean the boards. The advantage to this system is that it reduces the risk of the system not being able to clean boards, since it is based on the current system of cleaning them. The disadvantages are that it is a very complex system with a lot of moving parts, which reduces simplicity and reliability.

The final design we considered was a system using Ultraviolet light which would be used to sanitize the boards. This was Mackenzie's idea. The boards would be passed through a box which would have ultraviolet light which would kill all the algae on the boards. The advantages of this system are that it is very simple and would be unlikely to break. The disadvantage is that it would only kill the algae and not clean it off. This would not satisfy the requirement of it being visually clean.

We decided that the first design was the best choice. We first illuminated the final design, since the boards being visually clean is a requirement, and the final design does not satisfy it. While both the first and second design satisfy all the requirements, we chose the first design in favour of its simplicity. We were also concerned about the reliability of having all the moving parts required in the second design.

Drying/Storage System

We considered three designs for our drying/storage system. When we arrived at this point, we had already decided on a power washing design which meant that this system would be required to dry the boards as well. The first design we considered was a drying rack that would require the user to manually unload the boards from the machine and load them into a drying system. The second design we considered was a bag with holes in the bottom which would be connected to the end of the system and the boards would fall into. The final design we considered was an automated drying rack.

Our first design, the manual drying rack, is quite simple. This was my, Randina's, idea. It involves the user pulling the boards out of the cleaning system and then standing them up in a system that would allow them to dry. The advantage to this system is that it would not increase the complexity or cost. The disadvantage is that it is not automated.

The second system we considered was a bag. This was Mackenzie's idea. It involves a bag connected to the end of the system which would catch the boards. We would also add holes in the bottom of the bag which would allow for drainage. The advantages of this system are that it would very cheap and automated. The disadvantage is that it would not allow for as good of drying.

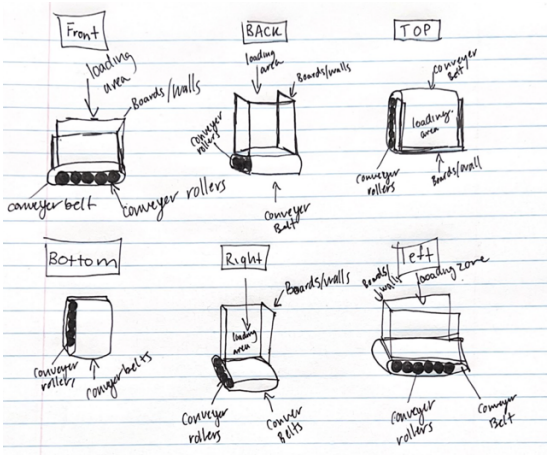
The final system we considered was an automatic drying rack system. This would work by having a belt that operates in a vertical direction. Connected to this belt would be paddles which would hold one board each. This belt would rotate as the machine ran. The advantages of this system are that it is fully automated and that it would be very good at drying the boards. The disadvantage is that it would be very complex and therefore expensive.

We chose the second system. While it is not a complex system, it does satisfy the requirements of being automated, unlike our first design, and it is much simpler than our final design. The downside of this decision is that it will mean the boards will be less dry, however this is much better than the alternatives. The complexity of the final system meant that it would be significantly more difficult to build and maintain neither of which can be justified by the small increase in dryness of the boards.

Final Design

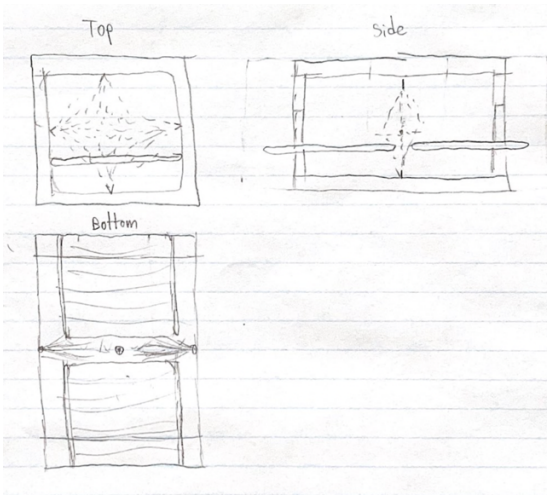
Loading System

We considered manual loading, a conveyer belt system, and a ceiling mounted conveyer system. We decided against manual loading both for safety and in favour of automation. We decided against a ceiling mounted system because we thought the system would exceed our price limit. Because of these limitations we decided that the conveyer belt system was the only valid option. Our solution involves a conveyer belt that pushes the boards through the machine allowing the following board to fall into place. We decided that this solution was favourable because it would be low cost and safe to use as the user would not be required to interact with the machine while it is running.



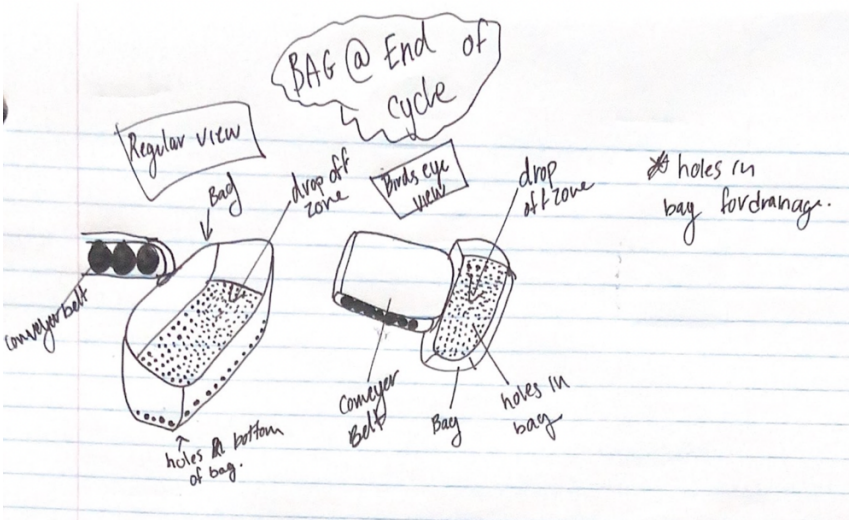
Cleaning System

We considered a Pressure washing design, a brush design and a design using Ultraviolet light to sanitize the boards. We decided against the Ultraviolet light solution, because it does not satisfy the requirement of the boards being visually clean. We decided against the brush design because we thought it would make it have too many moving parts making it unreliable and unsafe. We also thought it would be unfeasible for the system that could reliably clean inside the holes in the board while staying within the price limit. Because of this we decided that a pressure washing design was the most feasible option.



Drying/Storing System

We considered a bag design, a manual loading onto shelf design and a drying rack design. We decided against a manual loading design because it does not satisfy the goal of being automated. We decided against a drying rack because to design it to be automated would exceed our price limit. Because of this we decided that the bag was the only feasible option. In order to allow the boards to dry, we intend to put holes in the bag. We do believe that this solution will not be optimal for the drying of the boards but decided that the price was of more importance.



Conclusion

The final design is both a simple and flexible solution. The advantage of having only one moving part is that it will allow the system to be very reliable. This also will allow our solution to be able to be easily slowed or sped up depending on whether there was need for increased level of cleaning or not. The design also means that if the system does not clean adequately, for example if the boards were left to grow mold by accident, the user could easily run the boards through a second time, and there would be almost no extra time spent. The advantage of the bag at the end is that it satisfies the requirements of the drying storing system, in that it will store and dry the boards, without increasing the complexity and the cost of the system.