Requirements Document

ELEC 491 Capstone
Dynamic Projector Mount Project

Andy Kwan ████████
Smaran Karimbil ████
Siamak Rahmanian ████
Dante Ye ████████

Executive Summary

Our team's project is to prototype a dynamic projector mount that allows a user to remotely adjust a position of a projector in a theatre. Our client, Tim Herron works at the BC Hydro visuals presentation theatre, which can use up to 6 projectors that are installed at a height of 4 meters. Whenever the projectors need to be adjusted or configured for a particular presentation, Tim has to bring out a lift and manually reposition the projectors. Each year Tim spends more than 300 hours on this process. The dynamic projector mount allows remote control of projector positioning, for both pan and tilt movements. Through wireless technology paired with electric motors and custom mechanical mechanisms this product saves time and reduces cost of operation. This will also encourage users to be more inclined to put on presentations that require unique projector positions and moving projections. The ease of use and access to positioning of large theatre projectors makes it ideal for use in settings other than a theatre, including concerts, exhibitions, parties, sports events, and raves. Our team's project will not only explore a possible upgrade to UBC's BC Hydro Theatre, but also allow us to determine through integration, engineering, and prototyping whether a dynamic projector mount is practicable. The current prototype is functional with a few operations that involves minor refinement and optimization.

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Context

The Dynamic Projector Mount project was designed to help our client, Tim Herron, who works with the BC Hydro Theatre at the UBC CIRS building. Tim Herron experiences a lot of fatigue, accessibility inconvenience, and time loss when adjusting the configuration and orientation of the projectors in his theatre. Each time a presenter uses this theatre for an event where the projectors need to be repositioned, Tim has to pull out the ladder, rent a machine to lift him up or hire a specialist in order to reach and configure the ceiling projector mounts. The current projector mounts require hand tools and human sight to align the projected image as required for the presentation. This quickly becomes a very tedious task when multiple projectors must be configured. This process is time consuming and costs an estimated 300 hours per year. It is also very inconvenient, reducing the frequency of changing their positions.

With the dynamic projector mount Tim will be able to regularly change the orientation of the projectors without the use of special equipment in a short period of time.

Domain

The Dynamic Projector Mount project is intended to develop into a commercial product that is designed for the visuals and entertainment industry. This includes environments such as theatres, concert stages, art displays, raves, and light shows. It orientates large projection devices and objects such as projectors, light boxes, cameras, lasers, and spotlights in the motion of pan and tilt.

Functional Requirements

Functional requirements describe the behaviours and features that the dynamic projector mount must be able capable of performing
1. The projector mount rotates the projector along the vertical axis to allow panning motion.
2. The projector mount rotates the projector along the horizontal axis to allow tilting motion.
3. The projector mount operation to move the projector is controlled remotely

Non-functional Requirements

Nonfunctional requirements describe the reliability and the extent of the functional requirements.

1. The projector mount has adjustable preset positions
2. The projector mount is rated for a projector payload of 40 kg with a factor of safety over 2 resulting in a 80 kg limit
3. All movements of tilt and rotation are smooth with a precision of 3 centimeters on BC Hydro Theatre's projected surfaces which translates to 0.1° of movement of the projector.
4. The pan motion sweeps -180° to +180°
5. The tilt motion sweeps -90° to +45°
6. The projector mount can be easily powered from any outlet
7. Creating a projector mount which can be converted to mass manufacturing.
8. The app should allow the user to save custom projector mount position.
9. The projector mount remote control must have a range of 10 meters so as to control the projector from anywhere in the BC Hydro Theatre
10. The control interface ensures troubleshooting indicators for the client
11. The projector mount must be reliable such that it does not require anyone to reach it physically anymore often than adjusting and repositioning the original manual projector mount

Constraints

Constraints are factors that have limited the range of solutions.

1. The projector mount including the projector payload must be under 400 Kg total so as to hang off the unistrut standard at the BC Hydro theatre
2. The project has a prototype budget of $1000
3. The project will be completed by April 2017
4. The movement of the projector is smooth so as to not damage the projector. The projector mount must accelerate when starting movements and decelerate before stopping to achieve this.
5. The mount must be controlled wirelessly as the mount is to be suspended from the ceiling
6. The control must be implemented through an iPad app, which is the client's preferred control device

7. The projector mount uses the universal bolt pattern that is compatible for coupling to all standard theatrical projectors.
8. The projector mount must use the universal unistrut standard that is compatible for coupling to the ceiling of the BC Hydro Theatre.
9. To easily save the multiple projector orientation as presets with customizable titles.
10. The projector must move with immediate response to continuous user inputs.

Further Development Recommendations

These are the recommendations for future development of this Dynamic Projector Mount project:
1. Allowing the mount to translate vertically on to adjust its height.
2. Expanding the app control for multiple projectors for theaters with more than one projector mount.
3. Expanding the app control to all the internal projector settings such as lens shift, input select, and accessing the internal projector menu
4. Designing a canvas on the IOS app to allow users to draw new patterns for automatic repetitive movement.