Photography System for People in Wheelchairs

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***Abstract* — Basic photography poses difficulty to people with physical differences. A lack of commercially available solutions was identified, and the subsequent solution was designed. The object of this report is to describe and evaluate the possible design solution created. Evaluation of the designed solutions identified a monopod as the optimal solution. The monopod consists of an attachment point for a wheelchair, onto which a retractable shaft is attached, which supports the digital single-lens reflex (DSLR) camera electronically controlled positioning mount. The device helps the physically limited to set up and operate camera functionality with little to no assistance. Evaluation of current market offerings suggests not only will the modified tripod be a viable solution to the issue, but also a probable solution for the lacking market. The device is to be implemented in a high school classroom setting to enable those with physical differences to participate in still imagery.**

I. Introduction

Currently available tripods do not offer enough flexibility, portability, and mobility for persons with physical disadvantages. Some of the challenges they face can include, but are not limited to, the inability to change the camera position at certain heights, manipulate the tripod effectively due to lack of strength, and access the camera due to the tripod's structure being unaccommodating. Oftentimes, people with disabilities cannot view through the camera lens or change the settings of the camera comfortably. While there is a wheelchair camera mount on the market currently to help persons with physical differences, it is restricted in the help it provides. This tool limits the range of height and angle the photographer can use, which is a big issue when wanting to take pictures from different views. The purpose was to create an alternative system with the same range of height as a standard tripod (about 40 cm -130 cm). This gives the user the ability to control the angle and position of the camera through a remote control or mobile application.

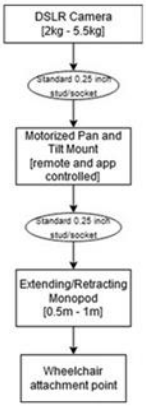

Figure 1: Flow Chart of Design Methodology

The photographer is able to simultaneously change the angle and position of the camera with the remote, observe the camera's viewfinder, and take the picture with the included remote or their smartphone. This system is portable, lightweight, and easily adjustable so that people with disabilities may use it without difficulty. This includes having a wide space under where the camera is attached, so that those in wheelchairs or with walkers can easily have access to the camera. Unlike commercial tripods, this system allows people with disadvantages to comfortably position the structure and change the height of the camera.

II. Design Description

A. Motorized Pan and Tilt Camera Mount

The objective of the pan and tilt mount is to allow the user to adjust the camera's positioning from a seated position. The camera attaches to the mount via a standard 0.25-inch (6.35 mm) socket that comes on all cameras, tripods, and tripod accessories. This attachment makes securing the device into place simple and adaptable to most existing photography accessories. Once secured, the camera will not require any handling. The camera will be able to swivel left and right 180° and rotate up and down 180°. This was accomplished by using two standard servo motors. One to control pan and one to control tilt. These motors can meet the desired positioning adjustments. The mounts positioning adjustments can be made using a remote controller or a mobile application installed on the user's cellphone. This allows the user to position the camera in the intended position without having to extend and retract their arms to physically make the changes. The mount is joined to the extendable and retractable monopod. The motorized mount is built using ABS plastic and aluminum to ensure the device remains sturdy and lightweight. People with physical differences often have difficulty maneuvering heavy objects Hence, the design placed significant importance to being as light as possible while meeting the necessary photography criteria. The target was to keep the overall mount to a weight under 1.5 kg to minimize the overall weight of the device and make it accommodating to a large variety of physically limited individuals.

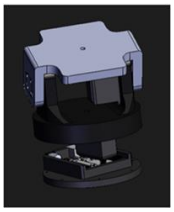

Figure 2: Camera Mount

B. *Motorized Center Column*

The camera mount sits on top of the structure's center column. In order to be able to change the height of the camera, a linear actuator is used for the center column. This is constructed with a motor, long threaded screw, a nut, and two aluminum sliding tubes. The rotary motion from the motor is converted to linear motion, causing the inner tube to move up and down. With this linear actuator, the camera will be able to have a displacement of about 12 inches (30.48 cm).

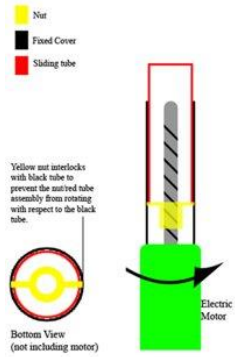

Figure 3: Linear Actuator

C. *Wheelchair Mount System*

Most tripods have three legs for stability, but this monopod includes a rectangular aluminum tube with a length of 381mm, that reaches across the user's lap. This tube is the base that carries the load of the motorized pan tilt camera mount and center column. L-shaped connectors were designed to extend the aluminum tube horizontally to accommodate varying wheelchair arm distance. The horizontal extension is done through slots which are implemented through base and connectors. The slots are locked in place through a quick-release locking mechanism which includes a clamping-handle with a T-shaped thread. Attached to the connectors are angled mounting brackets to increase the height of the monopod and provide clamp support. Two toggle clamps go directly through the mounting brackets and clamp to the wheelchair arms.

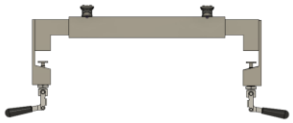

Figure 4: Wheelchair Mount System

III. RESULTS

A. *Testing*

Once constructed, device functionality testing was conducted. The motorized monopod was tested to ensure it met the previously discussed requirements. The base structure was loaded with weight surpassing that of the device assembly to ensure rigidity, longevity, and stability of the structure. Once structure requirements were verified, the extending and retracting center column component was tested. The client required the device to extend to a height maximum of 1 meter. The column was tested to ensure it could reach the required heights under load. Like the structure, the component was loaded in excess to conduct rigidity and function testing. Once the column functionality was verified, the three structure components were assembled to test the electric mount function. The mount can pan and tilt in a 180° field, meeting the range requirements. The mount remote communication was tested by simulating a photography environment to ensure desired function. As a complete device, the motorized monopod met the requirements of the client to be released for use.

B. *Implementation*

The device is to be implemented and used with high school students with physical differences.

IV. CONCLUSION

The design of a photography system for persons with physical differences is valuable device as there are currently no available devices that provide the needs for photographers with physical disabilities. Professional photography operates using both gross motor and fine motor skills. Though this may seem simple to those without disadvantages, it becomes complex on those with them. The modified motorized tripod discussed accommodates persons with physical disadvantages and allows them to freely participate in photography.

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