Project Trifecta
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Introduction

Professionals in dynamic workplaces such as surgeons (Fig. 1), chefs, mechanics (Fig. 2), and assembly line workers often need both hands free to do their jobs but must frequently view information on displays.

Ease of Use
Competing products

Safe Operation
Figure 8: Pan Tilt mechanism
Pneumatic actuators
Our cables, motors, and pulleys are very sturdy, and our 3d-printable pan tilt mechanism is very easy to maintain, keeping upkeep costs low.

Scalability
Reducing oscillations

Reliability
7: Stepper motor, driver, and PSU

Producing and Development
Afterwards, we developed criteria and ranked ideas to finalize a design. The group chose to use cables (Fig. 5), this reduced bulk and were less obtrusive than rails. Additionally, the group was inspired by an existing differential pan tilt system and created a fully custom design to fit the group’s purposes.

A bill of materials was created (Fig. 6). As many parts as possible were sourced from group members’ personal supplies, only a few components needed to be purchased. A scale model was built at the IGEN shop for testing code, and a full scale model was constructed in a group member’s garage. Group members met a few times a week at the garage to assemble the full scale prototype.

The pan tilt system went through one major iteration and proved to be successful. The pan tilt system went through several major iterations and proved to be successful.

Physical Design

The design consists of three primary stepper motors handling the motion system (Fig. 7). These large motors each are connected to a motor driver and power supply. These are placed on the ground, below pulleys mounted to the ceiling.

We used the C-Sketch method during our initial brainstorming. Some early designs involved:

• Four cables instead of three
• Rail-based movement (Fig. 4)
• Heavy pan-tilt counterweights
• Separate horizontal and vertical movement cables
• Pneumatic actuators

Each motor driver is wired to an Arduino Mega, where commands are fed from a computer (Fig. 11).

Software Design

Although remote control systems were outside the scope of our project, the underlying framework was designed to make future developments in this area seamless. The block diagram below illustrates how inputs from a serial monitor or future remote-control systems are processed and turned into motion (Fig. 12).

Inverse kinematic equations (Fig. 13) are used to calculate our systems desired path vector and subsequently calculate the change in cable length required for each XYZ stepper motor (Fig. 14).

Future Development

We fully met our main goals and are now looking forward on how the scope of the project could be expanded. Potential developments include:

• Reducing oscillations at the platform with active vibration damping
• To reduce XY oscillations and improve safety, but cracks and excessively noisy dampers can be added to the off-the-shelf platforms
• Hands-free remote control, voice commands, and custom position setting

Our system has been designed with future remote control in mind. Users should be able to control the monitor hands-free.

Testing and Validation

To ensure our design met all our requirements, we evaluated our design in terms of our specified criteria, both quantitatively and qualitatively.

Consumer Cost and Reliability
Our total cost of materials was $202, less than many competing products on the market. Our cables, motors, and pulleys are very sturdy, and our 3d-printable pan tilt mechanism is very easy to maintain, keeping upkeep costs low.

Safety
Our payload weight of 1.5 kg is lower than our specified max weight of 2 kg. Each of our cables should support a weight of 45 kg, so they will not snap (Fig. 15).

Ease of Use
Lower speeds and a single point mounting were chosen to increase stability and decrease oscillations. The system’s sound intensity peaks at around 50 dB, approximately the level of normal conversation.

References