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Automatic Electric powered center stand for two wheelers

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ABSTRACT

The task of mounting two wheelers on the center stand can be challenging. It becomes more difficult in case of heavy two wheelers like the Royal Enfield or if the rider is old. The main motive of this project is to minimize the human effort required to mount the two wheeler on center stand. The proposed system consist of an actuating device (electric) that helps to lift the vehicle and balance it on the center stand. A switch is provided to control its operation and a micro controller is used to continuously monitor the vehicle and activates the actuator only if the vehicle is idle. The latter acts as safety feature avoiding mishaps when the vehicle is in motion.

KEY WORDS: Center Stand, Two Wheelers, Linear Electric Actuator.

1. INTRODUCTION

Two wheelers have been in use for long time now and it is not going to reduce any time soon. It has observed that for some people, mounting the vehicle on the center stand might be challenging. More so in case of heavy two wheelers like the cruise type, which has higher engine capacity making the vehicle heavier and bulky. The proposed system aims at providing a user friendly approach by minimizing the human effort required for the task.

2. DESIGN AND MODELING

Actuating Element: The foremost for designing the system is to decide on the actuating element that is going to help to lift the vehicle and balance it on the ground imitating the center stand. There three types of actuators that are commonly used, Hydraulic Pneumatic and Electric. Hydraulic and Pneumatic actuators have a lot of benefits like ruggedness and ability to withstand high loads and having constant force and torque without supplying more fluid/air. However using either of the mentioned actuators makes the system complicated because both requires a storage tank to store the incompressible fluid or air. And also there is chance of leakage of air or fluid which will render the device inefficient.

All these parameters taken into consideration helps in making a decision of choosing electric actuators for this particular system. Again the choice solely depends on the application as all the options has its own advantages and disadvantages.

Some of the benefits of using electric actuators specific to this application is that

a) They offer high precision control and have an accuracy range of +/- 0.0000315 inches.
b) Can be programmed quickly and offer feedback for diagnostics and maintenance purposes.
c) User has a complete control over velocity, applied force, torque and position.
d) Eliminates the problem of leakage and proves to be safer than the other two options.

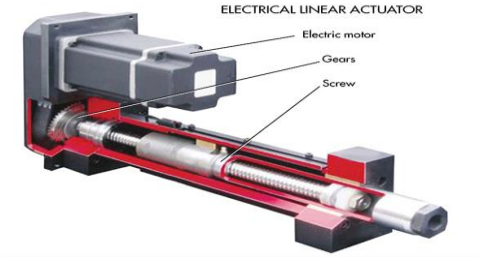

Figure.1. Linear electric actuator

The weight of the two wheeler along with the rider seated will be approximately 300 kilograms. The actuator used for this project is JC35DF linear electric actuator capable of withstanding up to 600kg load. The actuator use a DC motor to provide the torque required to lift a particular load. The performance characteristics of the actuator is given below.

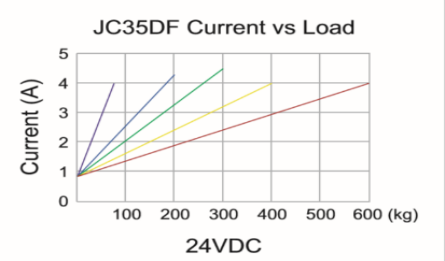

Figure.2. Current vs Load characteristics

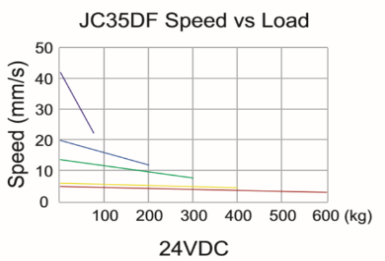

Figure.3. Speed vs Load characteristics

The main parameter to consider while choosing the actuator is the weight of the two wheeler. It is important to understand the difference between weight and mass. Mass is the measure of "stuff" in an object while weight is the amount of force exerted on the object due to gravity. In this project the combined mass of the vehicle and rider is approximately 300 kilograms while the weight is given by,

$$W=M*G \quad (1)$$

Where, M=mass of the object in kilograms, G=earth's gravitational force.

The weight of the object varies when it is in motion but since the vehicle is going to idle when mounting only the static weight needs to be taken into consideration.

The next parameter to look into is the Center of gravity where all the weight of the object acts upon, the identification of which will help in determining an ideal position to fix our setup in order to perfectly balance the two wheeler on the center stand. The horizontal position of the two wheeler's center of gravity can be determined by using the following equation,

$$X=\frac{Wr*Wb}{(Wf+Wr)} \quad (2)$$

Where, Wr= Rear weight, Wf= Front weight, WB= Wheel base.

Typically the horizontal position of the center of gravity is midway between the wheels giving a 50/50 weight bias between front and rear wheels. The position is determined with rider on board which makes the calculation is difficult because the riders position tends to change which will also cause slight changes in the position of center of gravity.

The next step in the design process is to choose the appropriate material for the frame which is dependent on stress and deformation the frame experiences while the bike is mounted on the stand. A structural analysis of the frame is done using ANSYS to observe the stress and deformation.

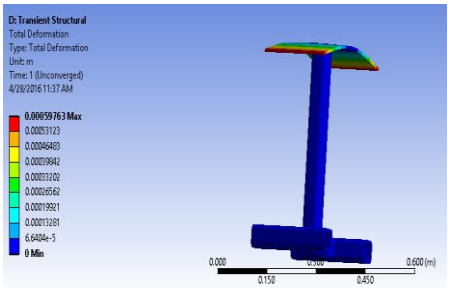

Figure.4. Total deformation of the frame

From the images of the analysis shown above it can be observed that the frame that is subjected to 3000N of force experiences a maximum stress and deformation at the flat surface mounted at the two wheeler. All these analyses suggests that mild steel will be the best contender for the design of the mount since. But taking the cost into consideration the project has been done with cast iron which is cheaper and stress, deformation characteristics close to that of mild steel.

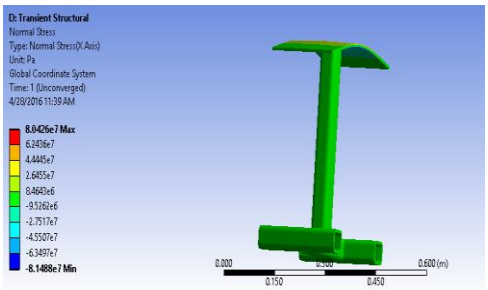

Figure.5. Total stress experienced by the frame

Proposed system: The proposed model is a smart electric powered center stand which is activated only when the two wheeler is idle. A main on/off switch is provided near the accelerator which the rider uses to operate the center stand. Since the stand can be activated by mistake when vehicle is in motion a safety system is provided to detect if vehicle is idle. Once the switch is ON a micro controller is used to detect whether the vehicle is idle or not, various parameters like speed, gear neutral indicator and occupant detection are taken as inputs by the microcontroller for this purpose. Modern two wheelers have both speed sensors and neutral indicators which can be directly given as inputs to the ADC of the micro controller. Occupant detection can implemented using load cell or pressure sensors working on principle of change in resistance. The microcontroller can be programmed to only detect weights more than 60/70 kilograms. The micro controller checks for all these conditions only after the main switch is switched ON hence there is no chance the system will malfunction.

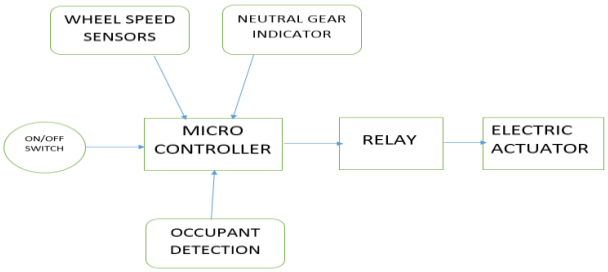

Figure.6. Block diagram of proposed system

ARM micro controllers are preferred because it will provide faster processing of data which makes the system more user friendly. A Royal Enfield bike is used to test the design because the system is modelled specifically for heavy two wheelers. Modifications were done in the chassis of the two wheeler in order to accommodate the motor of the actuator. Also the actuator arm was fully replaced with a cast iron arm in order to withstand heavy loads.

The actuator along with the mount is fixed right below the driver's seat in front of the rear wheel. This is not the exact position as determined using the formerly mentioned horizontal position of center of gravity but it was mounted as close to it as possible.

Figure.7. Testing the model

3. RESULTS AND CONCLUSION

Here an Electrically powered automatic center stand has been proposed. A detailed analysis of the frame and the actuators was done. The observations of stress and deformation analysis of the frame conforms to the design and safety of the system. On testing the model with a vehicle it was observed that the actuator was able to lift the two wheeler along with the rider and was perfectly balanced. The base of the frame has been fabricated such that it is suitable to mount it on any surface even if it is slippery. The safety systems proposed makes the design more efficient and helps in preventing any mishaps.

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