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Automatic Side Stand and Foot Rest Retrieval System

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Abstract - *Accidents in two wheeler vehicles can be fatal. The main reason which increases the risk of accidents is people forgetting to lift up the side stand of their vehicles. Also it is very common for the pillion rider to forget to unlock the footrest before taking his seat and trying to do that while the vehicle is in motion is a risky affair as it disturbs the balance of the vehicle. The main objective of this project is counter these problems. Electrically operated servo motor driven mechanisms are used to do the end job of lifting and unlocking the side stand and the footrest respectively. The mechanism works on the signals sent to it by a microcontroller circuit, which generates these signals based on the user code feed to it. By integrating this mechanism to the vehicle, the side stand will automatically left off when the ignition is turned on and the footrest will automatically unlock when an adult passenger is seated on the vehicle's pillion seat. To conclude, this project was designed to reduce the risk of accidents and to make two wheelers more fun and convenient for the rider and passenger and it does a good job accomplishing that.*

1.INTRODUCTION

Bike plays a very important role in our life. It helps to travel from one place to another place in very short time. Now a day's there are thousands of bikes running on the road. There is tough competition between the companies of the manufacturing different types of mechanisms. On the other hand percentage of accidents also increased. The problem is accident cause due to un-lifted side stand. During driving very time due to early, forget next or any other such reasons, rider forgets to lift the side stand, this is very necessary to have arrangements in the bike to prevent the accidents.

The automatic side stands works on the simple mechanism and no need to take extra power while operating. So it does not affect the vehicle efficiency and also suitable for any two-wheeler vehicles. The design of the vehicle is not affected only simple mechanism is added to the vehicle.

This is the new advancement in a bike with the facility to lift the side stand automatically. This may avoid an unnecessary accident in the day to day life. The mechanism of this project is simple that why it does not affect the current design of the bike. This is very cheap so we can install these features in any type of two-wheeler vehicles.

On the other hand dead pedal, often also called the foot rest, is typically a non-moving piece of rubber or metal that the pillion rider supposed to rest his or her foot. Foot rest in two wheeler is mainly for the safety, comfort and convenience of the pillion rider.

To overcome from all these types of problem, this work included the foot rest retrieval system. Minimum 10 Kg weight is required on the pillion seat, to retrieve foot rest automatically. It will provide the comfort and convenience for the pillion rider. With some modifications and ideas, automatic foot rest can be modified and can be use for driver's seat.

2. MATERIALS AND METHODS

Following materials was used for fabricating a working model of side stand and foot rest retrieving system.

- **Arduino**

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The arduino nano board is used for the side stand system; it has a flash memory of 32kb which is sufficient to run the code for the side stand system. The automatic footrest system though, requires more memory and hence arduino Uno is used for the footrest system.

The code for the side stand system integrates the potentiometer with the movement of the stand. The code for the footrest is written so as the movement of the servomotor is restricted to 90 degrees. These codes are written on the arduino IDE and uploaded on the board via a USB cable.

- **Potentiometer**

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider If only two terminals are used, one end and the wiper, it acts as a **v**ariable resistor or rheostat. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers.

The potentiometer used for the project is a 10K ohm rating potentiometer. It is integrated with a key switch by synchronizing the moment of its variable end with the rotation of the key switch.

Hence as the key turns towards ignition state the resistance that the potentiometer offers is reduced linearly which results in more current being fed to the arduino nano which is coded to respond to the increased input current by actuating the servo motor to which the stand is mounted.

- **Servo motor**

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

The motors used in this project are tower pro's servo motor MG995. This motor is capable of handling torque up to 11kg-cm which is well under the requirement of the project. . In both the cases the shaft of the motor is connect to a 28 teeth nylon spur gear which operates the stand and footrest mechanisms. The stand could've directly been mounted on the motors but that increases the load on the motors and makes them vulnerable to failure and damage. For this a centre shaft gear box is also used to take some load of the motor and for the smooth working of the mechanism.

- **Spur gear**

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially.

Four 28 teeth nylon spur gear were used in the construction of this project. Two for the side stand retrieval mechanism and two in the working of the footrest. These gears help transmit power from the motor to the actual load i.e. the side stand and the footrest. The gear ratio is so adjusted that it delivers the required speed and torque at the output.

- **Centre shaft gear box**

Gearbox is an automotive assembly of gears and associated parts by which power is transmitted from the engine to a driving axle. The term gearbox is sometimes also refers as transmission

A gearbox provides speed and torque conversions from a rotating power source to another device using gear ratios. Such engines need to operate at a relatively high rotational speed, which is inappropriate for starting, stopping, and slower travel.

A centre shaft gear box is mounted next to motor; at its shaft the second spur gear of the mechanism is mounted to which the stand or the footrest is fixed. The gearbox helps increase the mechanical advantage of the mechanism by reducing the speed and increasing the torque. Its responsibility is the smooth functioning of the whole mechanism. It basically takes some load of the motor and helps increase the stability of the system.

- **Limit switch**

In electrical engineering a limit switch is a switch operated by the motion of a machine part or presence of an object.

Two standard limit switches are used in this project, one at each of the systems. In the side stand retrieval system it is placed fixed above the spur gear mounted on the motor so when the gear rotates 90 degrees, the lever of the switch comes

in contact with the base and the circuit is completed. This limit switch actuates the indication LEDs glued on the panel, when the stand is in ride position, the green LED glows up via the circuit actuated by limit switch. In the footrest system, the limit switch is placed right below the spring of the seat. In this system, the limit switch is the main actuator; the mode of operations depends upon the position of the limit switch. When the seat is pressed by the passengers weight the lever of the limit switch is brought down completing the circuit and then the arduino Uno signals the servo motor to turn 90 degrees.

When the weight of the passenger is released i.e. when the lever of the switch goes up the footrest does not immediately go back to its initial position, instead it stays in ride position for some time. This is because a delay is set in the code of the arduino Uno. This was done because when getting off of the vehicle the passenger lifts his body from the seat but his legs are still rested on the footrest for some time to help support them to land their feet on the ground. Also while going through potholes and speed bumps the passenger's weight may fluctuate and at times go below the limit for a fraction second. So taking such scenarios into consideration, the delay is implemented.

- **Key switch**

A key switch (sometimes called a lock switch to distinguish it from a key switch) is a switch that can be activated only by the use of a key. They are usually used in situations where access needs to be restricted to the switch's functions.

A key switch or the key switch of the vehicle is integrated and calibrated with the potentiometer to drive the whole side stand retrieval circuit.

3. CONSTRUCTION

L shaped bars of mild steel are used as raw material for fabrication of the chassis. At first reduced the length of the bar to 60cm by cutting it with an angle grinder and welding the other end (legs) to it with the help of an arc welding machine. The remaining piece of metal was also put to use, a 40cm bar was cut and welded at the top of the chassis 10cm from the rear end to support the rod on which the seat was to be mounted. A 30cm bar from the same metal piece was welded to the right side (from rear) 20cm from the rear end with the help of arc welding machine.

A long metal pipe of diameter 15mm was cut into two smaller 10cm and 25cm rods. The shorter rod is welded perpendicularly at the center of the 40cm bar and the longer one is welded at the front end bar. The handle and the panel were to be mounted on the front end rod. A cycle handle found in scarp were too used as the makeshift handle of the model for the project. This handle was welded on top of the 25cm length rod. A cycle seat from a local vendor was mounted on the 10cm length rod.

Two poly-carbonate of dimension 5cm x 10cm and 2cm x 3cm where used for the mounting of other motorized equipment. To mount these plates on the chassis we drilled four holes of diameter 6 mm using a drill bit, two 5cm from the front end and two at the free end of the 30cm bar. the bigger 5cm x 10cm plates is mounted at the front for the side stand system and the smaller 2cm x 3cm plate on the hanging bar for the footrest.

The servo motor and gear box are mounted on these plates right next to each other with the difference in their shaft axes equal to the distance between the centers of two spur gears (40mm dia) in mesh. This arrangement is the same for both mechanisms, only difference is the orientation. The gears are then fixed to the shafts of these two components. The load (i.e. the stand and the footrest) is fixed to the gear mounted on the center shaft gear box and the main output is delivered at this load.

4. WORKING

4.1 WORKING OF SIDE STAND RETRIEVAL SYSTEM

The primary input to this system is given by the user by turning the key to ignition. A key switch is used to take the input from the user. A potentiometer is integrated with a key switch by synchronizing the moment of its variable end with the rotation of the key switch. Hence as the key turns towards ignition state, the resistance that the potentiometer offers is reduced linearly, which results in more current being fed to the arduino nano. An arduino nano board is used as the microcontroller in the system. It is coded such that it senses the amount of current being fed to it as input and gives the output signal to the servo motor such that the amount that the motor rotates is synchronized with the amount of current fed to it. The code of the arduino is written in an IDE provided by arduino and is uploaded in the circuit via a USB port. The output signal of the arduino is given to the servo motor which works on PWM signal. To the servo motor a 28mm diameter nylon spur gear is mounted which is in mesh with another similar gear. This gear train is used for the transmission of power from the motor to the side stand (load). The gear ratio is so adjusted it delivers required speed and torque at the

output. A centre shaft gear box is used to increase the torque and take some load off of the motor. A centre shaft gear box is mounted next to motor; at its shaft the second spur gear of the mechanism is mounted to which the stand is fixed. The gearbox helps increase the mechanical advantage of the mechanism by reducing the speed and increasing the torque. Its responsibility is the smooth functioning of the whole mechanism. It basically takes some load of the motor and helps increase the stability of the system. The stand is fixed to the shaft of the gear box. A limit switch is fixed to the spur gear mounted on the motor so when the gear rotates 90 degrees, the lever of the switch come in contact with the base and the circuit is completed. This limit switch actuates the indication LEDs glued on the panel, when the stand is in ride position, the green LED glows up via the circuit actuated by limit switch.

4.2 WORKING OF AUTOMATIC FOOTREST SYSTEM

The primary input to the footrest system is the weight of the backseat passenger. If the weight of the passenger is more than 10kg the spring of the seat compresses and it comes in contact with lever of the limit switch placed right below the spring of the seat. In this system, the limit switch is the main actuator; the mode of operations depends upon the position of the limit switch. When the seat is pressed by the passengers weight the lever of the limit switch is brought down completing the circuit this allows current to flow to the arduino uno. The code for the footrest is written so as the movement of the servomotor is restricted to 90 degrees and it actuates the motor actuates the motor when an input current is fed to it. The output signal of the arduino is given to the servo motor which works on PWM signal. To the servo motor a 28mm diameter nylon spur gear is mounted which is in mesh with another similar gear. This gear train is used for the transmission of power from the motor to the footrest (load). The gear ratio is so adjusted it delivers required speed and torque at the output. A centre shaft gear box is used to increase the torque and take some load off of the motor. A centre shaft gear box is mounted next to motor; at its shaft the second spur gear of the mechanism is mounted to which the stand is fixed. The gearbox helps increase the mechanical advantage of the mechanism by reducing the speed and increasing the torque. Its responsibility is the smooth functioning of the whole mechanism. It basically takes some load of the motor and helps increase the stability of the system. The stand is fixed to the shaft of the gear box. The whole mechanism is similar to that of the side stand system except the orientation. In this the axis of the motor and the gear box all are pointing upward as opposed horizontal in the side stand system. When the weight of the passenger is released i.e. when the lever of the switch goes up the footrest does not immediately go back to its initial position, instead it stays in ride position for some time. This is because a delay is set in the code of the arduino uno.

Assembly of side stand and foot rest retrieving system is shown in Figure 1.

Fig: 1 Side stand and foot rest retrieving system

5. OBSERVATION AND DISCUSSION

The time taken by the side sand to fully retrieve to ride position is measured. It is measured from the moment the key is turned to the moment the stand reaches the ride position. The time is measured in milliseconds with the help of the stopwatch application present in smart phones. (Refer Table 1)

Table 1: Readings of side stand retrieving time

OBSERVATION NO	TIME (in millisecond)
1	923
2	934
3	929

4	923
5	925
6	932
7	930

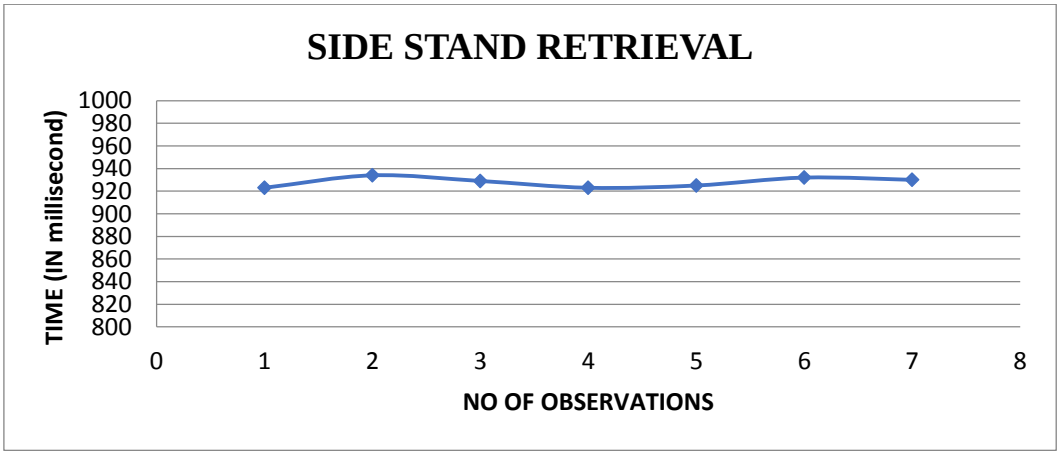

Fig 2: Graph showing side stand retrieval time

The time footrest takes to unlock from its rest position to ride position (i.e 90° rotation) is measured with the help of stopwatch application in the smart phones. The readings are taken in milliseconds. Graphically shown in Fig.2.

From the above observations we see that the average time taken by the side stand to go from its rest position to ride position is 928 milliseconds. This is the same amount of time it will take to go its rest position when the key is turned the other way (i.e. the vehicle is turned off). This much time is sufficient for the stand to get to rest position before the rider gets off of the vehicle.

Table 2: Reading of foot rest retrieving time

OBSERVATION NO	DELAY (IN millisecond)	RETRIVAL TIME (IN millisecond)	TOTAL TIME (IN millisecond
1	10000	633	10633
2	10000	635	10635
3	10000	639	10639
4	10000	630	10630
5	10000	640	10640
6	10000	642	10642
7	10000	635	10635

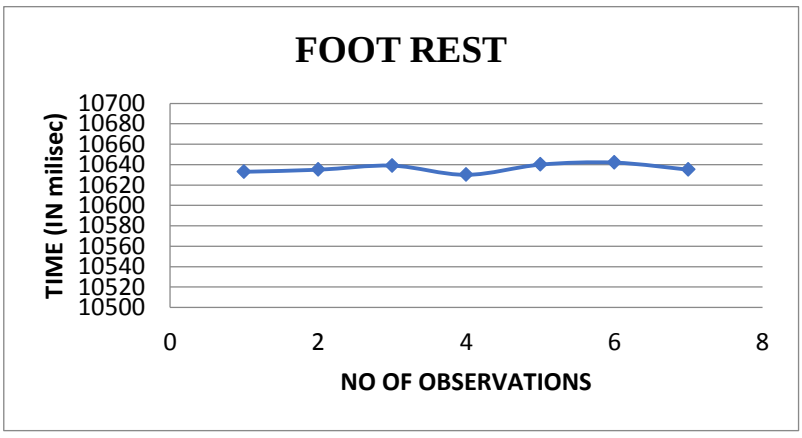

Fig 3: Graph showing foot rest retrieval time

From the above observations, the average time taken by the footrest to unlock is 636.28 milliseconds. This much time side enough for the footrest to open and be in place before the rider's feet land on the footrest. The observations are recorded in Table 2 and graphically shown in Fig.3.

Automatic side stand and foot rest retrieval system uses the same power source as every other electronic component on the vehicle i.e. vehicle's battery. The efficiency of working of the vehicle isn't compromised as it doesn't interfere with the workings of the engine. All components are light in weight as they're made of aluminum or plastic.
The cost of installation is reasonable. It can be integrated with very little modifications on the current stand and footrest designs.

6. CONCLUSION

The "AUTOMATIC SIDE STAND AND FOOTREST RETRIEVAL SYSTEM", if integrated properly with the existing vehicles will be of great use. The problem of accidents related to side stands can be completely solved. Also this system serves to be of major convenience for the user, and making something more convenient has been a major motivation behind all the inventions in human history, the mechanism of the project doesn't interfere with the working mechanism of the engine and hence the efficiency of the engine is not compromised. This idea can be taken to new levels if more sophisticated design and more sensitive equipment are used.

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