Design of automatic side stand and spring compression control system using arduino programming

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Abstract. Motorcycles are undoubtedly heavy, which commonly poses a problem when erecting the bike onto conventional double foot kick stands as well as it seems difficult to lift the bikes. So, using side stands is better to handle while parking bike, but it makes severe injury if the stand is not released. Most of the street side accidents occur due to lagging in releasing the side stand. This work mainly aims in designing an intelligent mechanism that automatically lifts the side stand when the driver sits in the seat. By using this control system whose setup has the ignition switch, pressure sensor, relay switch , motor drive , dc motor all controlled by the Arduino uno board through the programming interface, when the ignition switch is turned on and when the person sits on the seat integrated with spring, the spring compresses and the signals the motor to turn on and hence the stand slides up. When the ignition switch is turned off and low pressure sensed the side stand automatically pulls out to withstand the two-wheeler.

1. Introduction
Side stand in two wheelers act as a member in withstanding their load, while the vehicle is at the idle position. As the name suggests it has the integration of electrical and electronics part in it. When this integration happens wide variety of ideas and technologies can be implemented, and many solutions can be arrived. In this the Arduino uno, motor drive is of electronics side and motor, battery, etc. forms the electrical side respectively. So, as a result the costlier materials are safe guarded by cheap electronics materials. Which saves more cost and repair time, because they are readily available in the market and are of low cost. Thus, this kind of system is recommended for the society. Hence this work is based on the integration of both electrical and electronics which is of cheap, effective and off demand to the society.

Indeed, we are not the first to observe the flaws and limitations of the present-day vehicle automation systems. Several researchers have described earlier which are discussed as follows: Malika et.al [1]. In this the side stand retrieval is operated using the sprocket and motor attachment and leams through accordingly. Aswatha et.al [2]. The main aim is to offer safety through stand control by using GSM and arduino combination. Bharaneedharan et.al [3]. Here the passenger safety importance is secured through the multiple analysis of side stand retrieval using relay switches. Suresh et.al [4]. These deals with the integration of side stand design and safety analysis in real time conditions. Ecker et.al [5]. From this journal the safety and accidents cause and effect analysis across the region is
studied. Kritika et.al [6]. In this journal the security and safety are integrated using GSM, connectivity and mechanical link.

1.1. Objectives and parameters
The main objective of our project and the idea behind it, is to improvise the safety of the user or driver of the vehicle and reduce the sudden mal-function of the sliding system involved in it, which is present in the conventional automatic side stand system. Based on the detailed study of the references and conventional system, the parameters chosen for our project are based on Two-wheeler accidentals and occurrences, side stand and frame design, drive and power aspect of the system.

1.2. Principle of working
The device consists of Motor drive (L293D), Motor, Arduino UNO R3, Side Stand, Ignition switch and a Battery. Battery capacity is about 12volt and 4.5 amps with both positive and negative junction. Then for power drive, a motor of 12 volt and 2 amps is required to lift upwards and downwards respectively. These specifications are found based upon the design calculations and the cad modelling and the analysis by using suitable software’s and references. Now all these are collectively integrated into a working interface by using the Arduino Uno R3. It has micro controller chip, were the c programs can be stored to give instructions to operate the whole system automatically without human interference. Now the ignition switch is connected to the arduino R3 along with side stand and pressure pins respectively. The other side consist of the drive and the motor side which is connected to the arduino side itself. Then the motor is connected to motor drive (L293D). This drive is connected to the battery supply. The motor spindle is welded to the side stand of a bike .Motor spindle is fixed in 6mm drilled shaft .By fixing the shaft to the spindle of a motor, a motor is controlled by the drive, from which power supply is provided .The motor is clamped at a designed plywood stand with a help of c-clamp. All the connections are made through connecting wires and all were preparedly soldering with alloy materials. Motor rotations is pre-programmed in both clockwise and anti-clockwise directions.

1.3. Comparison of mechanism of various system
The existing mechanical slider is mostly composed of mechanical components like sprocket, chain drive, and stopper. The main dis-advantage is that less efficiency, more chances of failure, high maintenance. In- case of the complete electronic system involves the use of GSM for connectivity and connectivity for the operation of side stand sliding system. This system also has the constrain of poor connectivity chances. Hence the system may fail due to low or poor GSM connection. So, all these individual systems of mechanical or electrical system would surely lead to failure and would not be a reliable system for safety of the driver or user of the vehicle. As a result of in depth study of pros and cons of the existing system, we have come up with our idea of integration of both mechanical and electric system into an single system, which makes use of spring , Arduino uno, motor for the sliding and both return system. The dis-advantages of existing system like Low efficiency, high maintenance, poor safety of driver (user) are overcome using our integrated side stand system.

1.4. Comparison of statistical analysis of ours and conventional system
By this we conclude that, our system would ensure a better way of safety and increased efficiency when compared to the existing systems.
Table 1. Comparison table based on the various references and our project.

| S. No | Conventional system name                                                                 | Design and aesthetics (%) | Chances of malfunction (%) | Drive for system efficiency (%) | Production and maintenance cost (%) | Safety (%) |
|-------|------------------------------------------------------------------------------------------|---------------------------|---------------------------|---------------------------------|-------------------------------------|------------|
| 1     | Automatic side stand and footrest retrieval system                                        | 60                        | 59                        | 74                              | 52                                  | 56         |
| 2     | Two-wheeler side stand system using arduino                                              | 64.5                      | 55                        | 79                              | 45                                  | 61         |
| 3     | Motor driven side stand retrieval system                                                  | 69                        | 49                        | 82                              | 38                                  | 68         |
| 4     | Automatic side stand and spring compression control system using arduino programming      | 73                        | 43                        | 84                              | 30                                  | 74         |

2. Construction components

2.1. L293D motor drive

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.
Table 2. Pin configuration of L293D motor drive, data sheet from BOSH industries Pvt, Ltd.

| Pin No | Function                                      | Name          |
|--------|-----------------------------------------------|---------------|
| 1      | Enable pin for Motor 1; active high           | Enable 1,2    |
| 2      | Input 1 for Motor 1                           | Input 1       |
| 3      | Output 1 for Motor 1                          | Output 1      |
| 4      | Ground (0V)                                   | Ground        |
| 5      | Ground (0V)                                   | Ground        |
| 6      | Output 2 for Motor 1                          | Output 2      |
| 7      | Input 2 for Motor 1                           | Input 2       |
| 8      | Supply voltage for Motors; 9-12V (up to 36V)  | Vcc 2         |
| 9      | Enable pin for Motor 2; active high           | Enable 3,4    |
| 10     | Input 1 for Motor 1                           | Input 3       |
| 11     | Output 1 for Motor 1                          | Output 3      |
| 12     | Ground (0V)                                   | Ground        |
| 13     | Ground (0V)                                   | Ground        |
| 14     | Output 2 for Motor 1                          | Output 4      |
| 15     | Input2 for Motor 1                            | Input 4       |
| 16     | Supply voltage; 5V (up to 36V)                | Vcc 1         |

2.2. Spring and its properties
The spring is used here is outer diameter round coil stainless steel. The spring is chosen in such a way that the compression and expansion occurs only when 60kg to 70kg weight is levied on it. The spring is placed inside the seat of the two-wheeler. When the weight is applied the compression occurs thereby signal is received in Arduino and accordingly the stand moves up and vice-versa.
2.3. Motor
The motor used for this application is DC motor. The motor is programmed in such a way that it rotates in both clockwise and anti-clockwise direction. So, the basic work of motor is to rotate in clockwise direction and lift the stand from ground to rest or horizontal position. When the motor rotates in anti-clockwise direction, the stand must move from the rest or horizontal position to the inclined position leaning towards the ground.

2.4. Arduino uno R3
The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It is to be powered by an AC-to-DC adapter or battery to get started. This R3 is installed with program and then operated from battery supply to command and control the whole system respectively.

2.5. Connection cables
The whole connections starting from the key terminals, till the end of the motor rotating near the stand are given through the male-male and male-female cables respectively. The male-male connection is used to connect two terminals of the electric components. Whereas the female-female connection is used to connect one terminal and one supply port respectively.

3. Working flow – chart
4. Design calculation

WIRE DIAMETER = 3 mm = 0.003m
SPRING WEIGHT = 56 gms
COMBINED WEIGHT = 0.400 + 0.56 = 0.456 kg
COIL DIAMETER = 27 mm = 0.027m
COIL INNER DIAMETER = 21mm = 0.021mm
NO. OF COILS (n) = 17
FORCE DUE TO STAND (F) = mg sin
= 0.456*9.81
= 3.4267 N

FORCE = K *x
= 1.732 * 1.21536
= 2.105 N
Where K=Stiffness of spring
TORQUE:
T = F*R
= 2.105*0.11
= 0.2315 N-m
TORQUE DUE TO STAND WEIGHT:
STAND WEIGHT = 400 gms
POWER = 19.078 Watts
TORQUE DUE TO STAND WEIGHT (T2) = F * R
= 3.426*0.11
= 0.3769471 N-m
TOTAL TORQUE (T) = 0.23157 + 0.37694
T = 0.60887 N-m.
FREE LENGTH OF SPRING (L) = πdN
= 3.14 * 0.027 * 17
= 1.44126m
SPAN WEIGHT = (0.056 + 0.400) kg
= 0.456 kg
5. Design and analysis

![Figure 4](image1.png) **Figure 4.** Frame subjected to bending stress.

![Figure 5](image2.png) **Figure 5.** Design of side stand.

![Figure 6](image3.png) **Figure 6.** Frame subjected to von-mises stress.

![Figure 7](image4.png) **Figure 7.** Design of support frame.

6. Program to control the whole system

```c
/* taking pin 13 as lock key it must be at gnd to operate high means locked
 * taking pin 12 as pressure pin it gives high output if detects pressure
 * taking pin 11 as standard pin it gives high output if stand is present
 * motor driver pin is 7 and 8 if 10 it is clockwise and if 01 it is anticlockwise
 */

/* Setup:
 * connect one of the starter pins to 5v and another to pin 13
 * the pin 12 is the signal pin for pressure measurement give to 5v for detection
 * the pin 11 is the signal pin for standard give it to 5v for detection
 * pin 7 connect it to --> A of motor driver
 * pin 6 connect it to --> B of motor driver

int pass =0, forward = 0;
void setup () {
    pinMode (13, OUTPUT);
    digitalWrite (7, LOW);
    pinMode (12, OUTPUT);
    digitalWrite (6, HIGH);
    pinMode (11, OUTPUT);
    digitalWrite (7, LOW);
    pinMode (7, OUTPUT);
    digitalWrite (7, LOW);
    digitalWrite (6, LOW);
    delay (300);
    digitalWrite (7, LOW);
}```
pin Mode (6, OUTPUT);
digital Write (13, LOW);
digital Write (12, LOW);
digital Write (11, LOW);
digitalWrite (7, LOW);
digital Write (6, LOW);
}
void loop () {
if (digital Read (13) == 0)
{
while(digital Read(12)== 1 && digital Read(11)
== 1 && digital Read(13) == 0)
{
    if(pass == 0)
    {
        digitalWrite(7,HIGH);
        digitalWrite(6,LOW);
        delay(300);
        digitalWrite(7,LOW);
        digital Write(6,LOW);
        pass = 1;
        forward = 1;
    }
    }else{
        digitalWrite(7,LOW);
        digital Write(6,LOW);
        pass = 0;
    }else{
        digitalWrite(7,HIGH);
        digitalWrite(6,HIGH);
        delay(300);
        digitalWrite(7,LOW);
        digital Write(6,LOW);
        pass = 1;
        forward = 1;
    }
}
}
if(forward == 1)

7. Conclusion
Now a day’s accidents related to side stand slider are more often reported. The integration of “AUTOMATIC SIDE STAND AND SPRING COMPRESSION CONTROL SYSTEM USING ARDUINO PROGRAMMING” in any existing two-wheeler improve the safety of the user (driver), design and aesthetics of the system, drive system and overall efficiency. This system will of greater convenience for the user, as it is having lesser chance of mal-function and the cost as well as maintenance of this system is cheap compared to other conventional systems. Also, the design and drive for this system is independent of the main engine and transmission system, unlike other system this will not interfere in the working of the two-wheelers. This system will surely be an economical and safe system in all aspects for all class of vehicle. This technology can be further developed into a sophisticated one, if electronic circuiting and design ergonomics of the system is improvised respectively.

8. References
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