Arduino based Hardware Implementation of Automatic Side Stand for Motor Bike

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Abstract— Usage of motor bike is preferred by most of the people for it is an easy way for transport and it needs a little space comparatively on parking. But when accidents happen, it causes severe injuries and sometimes deaths as well. There are many reasons for these accidents, internally and externally. Forgetting to lift up the side stand is one of the reasons and it could be avoided by certain technical aspects. This paper presents an automatic side stand for motor bikes, which could be lifted up while the bike starts moving and retrieve back when it stops. The design consists of sensors, relay switches and regulators which are controlled by Arduino UNO program. There is no need to additional energy source or any other complexity since the designed system uses the necessary power from the motor bike battery.

Keywords—Automatic motor bike side stand; smart motor bike; Arduino pro mini; gear shift system; lever mechanism; accidents

I. INTRODUCTION

Motorcycle is the easy transport mode all over the world when considering speed, traffic, parking space and safety. It can be proved by statements from few research works. Usually vehicles keep on circle the road network until it finds an available parking slot [1]. This leads to road traffic and in turn increases the fuel consumption and affects the quality of the environment [2]. Such problems are eliminated if the usage of motor bike is entertained in cities.

The side stand of motor bike plays an important role while the vehicle is in rest position. But it has some disadvantages when the vehicle is moving, if it is not lifted. If the bike rider forgets to release the side stand, it will cause to accidents when taking left turn. Even though some motor bikes have indication of side stand position in head panel, quite a number of accidents are still occurring due to this particular reason. So it is necessary to apply a mechanism to lift the side stand even if the rider forgets to lift it when he starts riding. The system developed here is automatically lifting and retracting the side stand through mechanical cum electronic arrangement. The system is working with the sensors, actuators and using the limit switch signals. Mini-Arduino board is used to give conditions to control the system and to program it.

The conditions are given as follows. When the key is off and no weight on the seat, the stands should come down automatically. When weight is on the seat and key is turned on, the stand should be lifted up automatically. This side stand mechanism can be installed to any kind of motor bikes irrespective of its gear arrangements. Also it is easier to install, because it is not dependent on any other existing systems of a motor bike. The proposed system is small. Separate power source is not necessary; it'll work on the present power generating system of the motor bike. Moreover it is safer than the other kind of stands which have already been designed by researchers.

II. LITERATURE REVIEW

Mr. V. V. R. Murthy et al. [3], Sumit Pandit et al [4], Bharaneedharan Muralidharan et al. [5] and Pintoo Prjapati et al. [6] used power transmission from engine to rear wheel through sprocket as a mechanism to lift the side stand up. It gains the power from the chain and make specially designed lifting lever to rotate. The retrieving of side stand when the motor bike comes to rest is not discussed here. Since the lever mechanism connected with sprocket and chain, this mechanism give extra friction to the normal riding procedure. Pravin Barapatre et al. [7] and R. Selvendran et. al [8] made an automatic bike stand using lever mechanism attached with the gear. But it can be used to bikes which has ''all up'' gear shift system; and cannot be used to ''One down rest up'' gear shift system. Also the side stand will be retrieved according to the design, when the bike comes to neutral gear in signal lights, which is an unwanted disturbance. Aniket Gulhane et al. made a similar model with mechanical linkage system [9]. But it is not applicable to motor bikes which have auto gear box

system. Lifting up of stand is automatic but retrieving of stand is manual is the drawback in this work. Vishal Srivastava et al. used sensor and microcontroller unit to lift the side stand up. A speed sensor is mounted on the front wheel and the motor works according to the signals send by it to engage and disengage the side stand [10]. This method also has the same problem of retrieving of side stand when the bike comes to neutral gear in signal lights, since the wheel won't move. Whether the side-stand work based on start button control or speed sensor control is not clearly discussed here. Amit Singh et al. have designed a side stand lifting mechanism based on the key on position of the motor bike. If the key is turned on, the side stand will be lifted [11]. But the scenario of retrieving the stand is not discussed here. Also if a kid accidently turn on the key, the side stand will be lifted and motor bike will be fallen down. So, accompanying all these problematic situations, this research work carried out and resulted in an improved system. It is also important to notice that according to the data of World Health Organization, in 2013; more than 286,000 motorcyclists were killed in road accidents [12]. In India 20% - 22% of motor bike accidents occurred by not lifting the side stand when the rider riding the bike [9]. A detailed survey about causes for motor bike accidents from 2012 to 2015 is provided by R. Selvendran et al. and 36% of total accidents caused by not lifting the side stand while riding [8]. The position of side stand leads the vehicle and the rider to lose the center of gravity due to the hindrance caused to side stand by the ground, if it is not lifted up while driving [13].

Vivek Vishwakarma et al. found the fixed height of the side stand as a problem and designed a side stand where the height of it could be adjusted [14].

III. METHODOLOGY

The proposed automatic side-stand for the motor bikes has two main components, a mechanical design & an electronic control. In other words control the normal motor bike side stand by programming through Arduino board is discussed here.

Fig. 1. Shows the flow diagram for the design set up. One limit switch is fixed at upside of the side-stand and the other one is fixed at the bottom of the side-stand. By these limit switches, the Arduino pro mini get the signal. The ignition switch also send signal to the Arduino pro mini through 10K resistor. By the convertor, current reduce from 12V to 5V; because Arduino pro mini requires 5V for its working. Arduino pro mini process the input signals according to the coding and processed signals sent to the current sensor, motor control drive, indicator and to buzzer. The items used and their specifications are mentioned in table. 1.

If the ignition switch turned ON, the input signal is given to the Arduino pro mini by the 10K resistor. According to the Arduino coding, the input signals processed and output signal will be given to the motor control driver. The motor control driver can ON/OFF the motor & change the rotational

direction of the motor shaft base on whether to lifting up or retrieving the side stand.

The side stand is programmed to be lifted up once the motor bike key turn ON. If the side stand comes to the upper limit, the upper limit switch sends the signal to the Arduino pro mini. According to the coding and command, the motor stop working and further lifting the stand is prevented.

TABLE 1. COMPONENTS USED

Components	Specifications
Arduino pro mini	AT mega 328
Inductor	LED 2.2V,20mA
Buzzer	5V, 200mA
Limit switches	SPDT
Motor	12V,17W,24Nm
Motor control drive	12V,15A, H-Relay bridge
12V to 5V convertor	LM7805,1A
Ignition switch	2 Position, 4 wire
10K Resistor	10kV, 1W
Current sensor	ACS 712,30A

If the ignition switch is turned OFF, the side-stand retrieve to bottom level and engage with lower limit switch. In the similar way, after engaging with limit switch, the motor is turned OFF automatically and further movement of side-stand is prevented. If there is any hindrance on the way of lifting-up or retrieving the side-stand, the motor is turned OFF automatically and the buzzer rings an alarm. Current sensor is used in this aspect. Current range is given to the motor based on the Arduino coding. More power is required to lift the side-stand, if there is any hindrance on the way of lifting-up or retrieving down. More power means, it needs more voltage and amperes to complete that certain task. If this current exceeds the prescribed limit based on the coding, the motor is turned OFF automatically and the buzzer rings an alarm and indicates the user by LED light. Since 7805 regulator can act as a step down transformer, it is used to convert 12V motor bike battery voltage into 5V system operating voltage. Excess voltage may damage the system. Once the 7805 regulator is fixed, the power in put wire can be connected directly to the battery. So, there won't be any changes in the electrical system by installing this new device with existing system. Safety of the new attachment is another concern. The new system must be water resistive. Since the side stand is in bottom part of the motor bike, there is high possibility of getting wet in rainy days. It is obvious that the system will not work properly under such situation. All the electronic accessories are placed in a separate box and kept under the
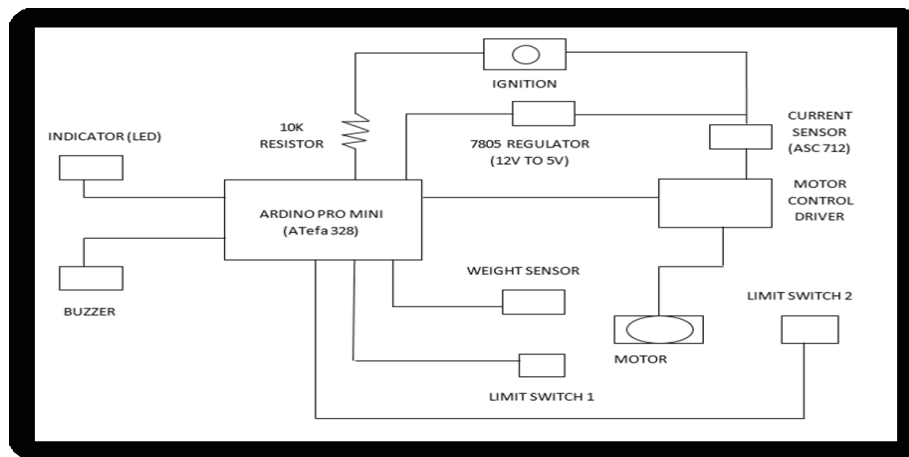
Fig. 1. Circuit diagram of the model.

seat to eliminate the above mentioned problem. If the system failed to work because of any problem, it would be indicated by an indicator light and an alarm sound. The system needs to be reset under such circumstance. Turn off and turn on the start key within few seconds is how the reset is programmed. If it is not working even after resetting, as like other systems in a vehicle, the help of a technician is required. In case of emergency, as like normal motor bikes, the side stand can be lifted up and retrieved back manually.

IV. RESULTS AND DISCUSSION

The side stand can be lifted up if both the conditions - turning the key on and rider sit on the seat are fulfilled. In the similar way the stand will be retrieved, if both the conditions key off and weight removed from the seat are fulfilled. The required conditions for the working of the side stand are summarized in table 2. The movement of the side stand and motion of the motor are controlled by upper and lower limit switches. The system will not work if any one of the condition is missed. And also if any resistance detected while the stand works, the system automatically shut off. Usage of sprocket, gear system or speed sensor to achieve the automatic functioning of side stand is not recommended in this research work.
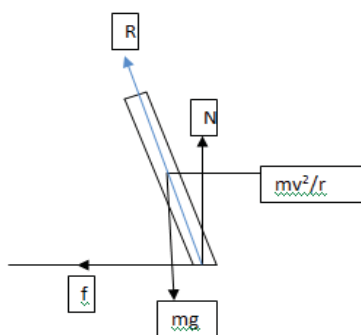

Fig. 2. Left turn of a bike if the side stand is lifted up

- R – Resultant force
- N – Normal Force
- mg – Weight of the bike and rider
- F – frictional Force
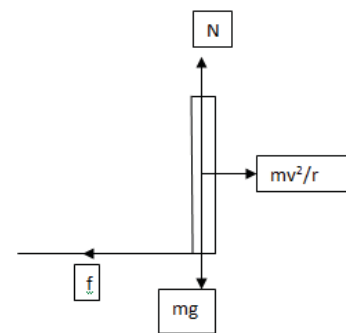- mv^2/r – Centrifugal Force

Fig. 3. Left turn of motor bike if the side stand is not lifted up

Automatic side stands already designed for ''all up'' gear shift system; but it is not possible to design similar mechanism to ''One down rest up'' gear shift system. In ''One down rest up'' gear shift system, first gear is downwards, 2nd, 3rd and 4th gear shifts are upwards. If the side stand is designed to lift up for 1st gear shift which is downwards, it would be retrieved for 2nd gear where the gear shift is upwards – the opposite direction of previous gear shift. Under normal conditions, without any side stand lift up mechanisms, the side stand hits the road and will be lifted up when taking right turn (most of the times) if the bike moves without lifting the side stand as shown in Fig. 2. In this condition all three forces meet at a point and resulted in equilibrium of the motor bike. A body will be in equilibrium if the following conditions fulfilled.

1. The lines of action should cross at the same point

2. The vector sum of the forces should be equal to zero vectors.

But in the case of ''One down rest up'' gear shift situation, the side stand will not be lifted up even if it hits the road, due to the arrangement of the gear shifts. This in turn will leads to the unbalancing of motor bike, unable to turn in desired curve, travelling away from the relevant arc and to collision with the vehicle travelling in opposite direction as shown in Fig. 3. Hence the equilibrium condition is not fulfilled and there is a resultant force which leads to the outward motion of the motorbike. So annexing the side stand lift up mechanism for bikes having ''One down rest up'' gear shift system makes the situation even worse.

Connecting the lever with the sprocket for automatic functioning of the side stand is also not advised in this research work. It is possible to lift up the side stand, when the motor bike started moving forward, if it is connected with the sprocket. But the retrieval of the side stand on stopping of the bike is not possible. If the side stand can be lifted up on forward movement of the motor bike, it can be retrieved down only if the bike moves backward, for which the motor bike does not have any reverse gears. Or else the manual retrieval needs to be followed in order to park the bike, which will create unnecessary wear and tear on the teeth of the sprocket. Both these above mentioned methods make the system more complex and introduce additional forces to the existing system.

TABLE 2. RESULTS AND OBSERVATIONS

Conditions	Output
key on and weight on the seat	Side stand will be lifted up
key off and no weight on the seat	Side stand will be retrieved
key on and no weight on the seat	No movement of side stand
key off and weight on the seat	No movement of side stand

V. CONCLUSION AND FUTURE SCOPE

1. Not only lifting up of side stand while start riding the motor bike, but also retrieving it to the normal position once it stopped is designed here.
2. Along with the turn On / Off of the motor bike key, another condition is introduced to ensure that motor bike is moving only when the rider is on the seat.
3. Usage of speed sensor is uninvolved. The speed drops to zero when traffic light is red and there is no requirement to retrieve the side stand at that moment.
4. It can be installed to any kind of motor bikes irrespective of the gear system, since it works on sensor and not connected to the gear system or sprocket.

Among total causes of accidents, around 20% – 30% of accidents occurring due to not lifting the side stand when riding the bike can be prevented by the method suggested

in this research work. But there is another 70% - 80% causes of accidents remain unchanged. Possibly in the future, to prevent deaths and injuries caused by motor bike accidents, airbag system can be installed as like in other vehicles.

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