International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Collision Avoidance System (CAS) for Motorcycles

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Abstract – *The following study focus on way how to avoid the accidents/collisions emerged between a motor cycle and the other vehicles. As till now there is hardly any safety systems developed for the motor bikes in order to avoid the collision. So this system made by us will help the bike rider to stay alert while driving on the roads while changing the lanes from one to another and also while making a turn at the t- points, etc. This paper aims and focuses on making the improvement for the motorcycle riders to avoid the accidents by introducing an alerting and decision making system.*

Key Words: *Bikes, brakes, Collision Avoidance System (CAS) high torque servo motors, indicator displays, motorbikes, motorcycles, radar and vibration pads.*

1. INTRODUCTION

According to the research done by the U.S. the motorcycle fatalities increased every year for 11 years after reaching a historic low of 2,116 fatalities in 1997, then increased to over 5,000 around 2008 and then plateaued in the 4 to 5 years. Also according to the **NHTSA** National Survey on motorcyclist and Pedestrians attitude and behaviour the motorcyclist were hit by a car with a rate of 30 percentages. So this research is done and focuses on to avoid the accidents happened between the two wheeler and a car by introducing a pre-crash system in order to avoid the crash with minimal or no damage [1].

This research is about making such system that will alert the bike rider about the incoming vehicle approaching from the blind spot that is from the back side of the rider. As the bikes has very lower space so there are very low possibilities to fit an electronic system. Also even if the system may be placed their will a problem of water draining and wear and tear of it. Instead it is very easy and efficient to place a safety system in the cars as they have a broader space and the system placed in remains intact with reduced wear and tear of it. As there are very less safety systems and gears in a motor cycle this research is done to avoid the crashing of the motor cycles with other vehicles by giving a pre-crash warning to the rider and to handle and avoid the crash by applying the brakes in the emergency situation. In this system the Doppler radars will be used in order to determine the position of the other vehicle passing by the motorcycle.

So the introduction the working of the CAS system for Motorbikes is as follows:

The Doppler radar belongs to the family of the RADARS. The Doppler radar is specialised radar that uses the Doppler Effect to produce the velocity data about the objects at the distance. It does this by bouncing a microwave signal off a desired target and analysing how the object's motion has altered the frequency of the returned signal. A Doppler effect is an increase in frequency of sound, light or other waves as the source and observer moves towards each other. In this case the Doppler radar will emit the microwaves towards, in the target detection range and will receive the Doppler frequency in order to determine the location of the vehicle passing aside by the motorcycle. In this system 3 Doppler radars will be used: one in the front of the bike and other two at the back to monitor the other vehicles.

The control unit consists of a microcontroller which takes some input data, processes it with the logic programmed in it, and then gives a desired output for the designed system. In the case of our system, the microcontroller present in the control unit will take the sample of the input frequency provided to the Doppler radar and the Doppler frequency received by it. Then these both the signals will be processed in a way to determine the Doppler Effect frequency. This frequency will be compared to the threshold point set by the programmer and the output will be generated according to it. This threshold point is the minimum range allowed to the vehicle to avoid the crash. As the Doppler frequency increase and crosses the threshold point the control unit will generate the output signals to alert the

rider that there is vehicle at left or right with the help of the indications and sensors.

The indicators are used to indicate or alert the rider about the on-going vehicle which is approaching from behind and with the direction from where. The indications are done by using a buzzer to make a high pitch sound so that the rider gets alert of the situation. Also the vibration pads can be used at the sides of the fuel tank where the thigh of the rider rests. The vibration pads will make the vibrations which will get sensed by the rider and will make him/her alert about the situation. These vibrations pads will be very useful if there are high pitch sounds around the environment of the rider as in those conditions the sound indications won't work. Also these vibrations pads will also determine the direction of the vehicle approaching towards the rider. If only the left vibration pad is active then it would be meant that the vehicle is approaching from the left. If the right side vibration pad is active then it would mean that the vehicle is approaching from the left.

The emergency braking unit will act only when it's needed that is when it's emergency. As sometimes the accident happens when the rider is moving at a high speed and the vehicle in front of him stops suddenly. Thus sometimes the rider don't get chance to handle the situation and gets freak out. So the front placed radar monitors the position of the vehicles in the front of the motorcycle. The front radar determines the position of the front vehicle and when the Doppler frequency crosses the threshold point the microcontroller generates an output signal which is feed to the emergency braking system. The emergency braking system is nothing but a automated program controlled braking where both the front and rear brakes are applied of the bikes by stretching the brake wires of the motorcycle and making it slow down to minimal or no crashing of motorcycle with the front vehicle.

If the motorcycle consists of ABS (Anti-lock Braking System) then this emergency braking system will work perfectly on it. The ABS avoids the brakes of the vehicle from being locked due to which the wheels of the vehicle may get stuck and make unstable and the rider may fall. Due to locking of the brakes the bike may skid on the road resulting in the injury to the rider. This system can be implemented on the non-ABS system as we just have to hold and release the brakes continuously with low power.

2. LITERATURE REVIEW

The literature review of the following papers and websites were done:

In a journal paper titled "An intelligent Frontal Collision Warning system for Motorcycles" Mr F.Biral, faculty of Engineering University of Trento, Italy have mentioned that the Motorcycle are among the most vulnerable groups of road users and current statistics show that they are involved in fatal crashes 20 times more than a car user. In his research the software and hardware architecture follows the "SenseThinkAct" paradigm. The sense layer processes the sensor data to flow reconstruct the vehicle state and surrounding environment; the decision layer assesses the manoeuvre's risk level and the act layer activates the proper Human Machine Interface (HMI). The sense layer includes the sensors like Inertial Measurement Unit (IMU) and a laser scanner which are used to determine the distance between the rider the frontal vehicle. The decision layer consists of the ARAS (Advanced Rider Assistance System) control module which makes the decision suitable for the rider by indicating. The action layer includes the HMI elements, the visual display. So display indicates the rider to act to the situation before it is too late [1].

In the other journal entitled "Motorbike Crash avoidance System with Ultrasonic Sensor and Android Application" Mr Nazrul Islam have made a collision avoidance system in which the Ultrasonic sensors and an android application is used to alert the bike rider. In his research he has used long range ultrasonic sensors which have a detection range up to 18m. This sensor emits an ultrasonic beam in the detection range in the front of the rider and this beams echo backs to the transducer. The microcontroller measures the time lag between the transmitted and received pulse. Then it is multiplied by the speed of sound in air the distance to the object is measured. Then the microcontroller sends some data to the Bluetooth module to be transmitted. The android application running in the android device receives the data transmitted from the Bluetooth module and alerts the bike rider by generating an alarm. In response to the alert the bike rider can take precautions to avoid a possible collision [3].

3. PROPOSE METHODOLOGY

The working of the Collision Avoidance can be divided in to 4 parts:

- The Doppler radar unit
- The control unit
- The indication unit
- The emergency braking unit

The Doppler radar unit consists of 3 Doppler units placed one at the front side of the bike and other two at the rear side at 45 degree with respect to the wheel at both sides. The Doppler radar transmits the electromagnetic waves and receives the echo signal. Then this echo signal is compared with the transmitted signal and the Doppler frequency is acquired. The more the Doppler frequency, near the object will be, and vice versa.

The control unit takes the radar signals as an input by all the 3 radars. These inputs are then processed through the logic stored in it by the programmer. The microcontroller analyses the distance between the object and the bike and if it goes on decreasing below the threshold point the indication signals are generated. This indication signals are then feed to the indication display and the vibration pads.

The indication unit consists of the display and the vibration pads. The display indicates the object approaching from behind the bike and also the direction of it and makes high pitch sound in order to alert the rider to the presence of the another vehicle. The vibrations pads are used when there are loud noises and sounds around the environment of the rider. The vibration pads produce the vibration stimulations placed at the side of the fuel tank where the thighs of the rider lie. These vibration pads alerts the driver by vibrating the corresponding pad from the side the object is passing by. Means if the object is approaching from left then the left vibration pads become active and if the object is approaching from the right side then the right vibration pad becomes active.

The emergency braking unit only depends on the frontal radar. If the rider is moving with a high speed and the object in front of him stops suddenly then this emergency braking comes handy. When the distance between the front object and the rider decreases and falls below the threshold point then the emergency braking system is made active by applying the signals generated by the microcontroller. The emergency braking system is nothing but a automated program controlled braking where both the front and rear brakes are applied of the bikes by stretching the brake wires of the motorcycle and making it slow down to minimal or no crashing of motorcycle with the front vehicle.

4. BLOCK DIAGRAM

The block diagram for the system designed and explained in the above theory is as follows:

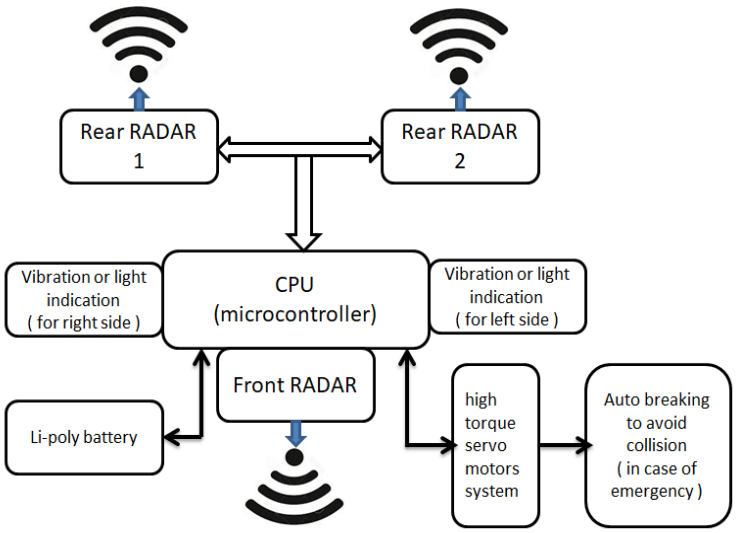

Fig. 4.1

The Fig. 4.1 Shows the block diagram of the CAS system for bikes. The function of each block is as follows:

The front RADAR and rear RADAR 1 and 2 transmit the electromagnetic waves in the directions they are set and give the received Doppler frequency to the CPU (microcontroller). Then the CPU applies some logic feed in it to the signals and compares it with the constant threshold point and acts according to it.

The vibration and light detection sensors are used to make the rider alert about the vehicles passing by in the real time. The high torque servo motors are used to generate enough force to stretch the brake wires. The auto braking system consists of the two wires which are coupled together to stretch both the brake wire simultaneously.

The lithium-polymer (Li-poly) battery is used to keep the microcontroller and all the other devices active while driving. A switch could be used to turn off the system in the condition when it is not needed. For example when the bikes are not in use or parked in a parking lot then to avoid the draining of the Li-poly battery. Or else we can connect the switch to the key section so that whenever the rider turns on the bike for a

run the CAS system will automatically get activated. So he/she don't need to turn it ON manually.

5. EXPECTED OUTPUT

By the use of this system the overall safety of the rider can be increased by just making him/her alert by some indications or senses.

When this system will work in the real world the n it can detect the distant targets at arrange of 20 m as the range provided RADAR is 20m. Also the 20 m range is sufficient for a rider to take decision and to handle the situation in the real environment under normal circumstances. This system would be able alert and indicate the rider about the vehicles passing by side of him with the direction. Also in the emergency cases like collision, the system will detect if the object is too close to the vehicle and if it is to close then the automatic braking system will get activated and the deceleration of the vehicle occurs. Due to which the CAS will help to reduce traffic accident fatalities and injuries [4].

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BIOGRAPHIES

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