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Automatic Helmet Detector

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Abstract - *Loss of lives due to motorcycle accidents is increasing. The major reason for such incidents is due to severe head injuries which can be avoided by wearing safety things such as helmets. So we designed a device that detects the presence of a helmet automatically and allows the driver to switch on his vehicle only if he wears the helmet. In this paper, we presented a method to detect whether the rider wears a helmet or not. Here we used YOLO V5 which is an object detection algorithm mainly used for recognition purposes. Here the camera is fitted in such a manner that it focuses the rider automatically when he turns on his bike. In so far existing models they used single-shot multibox detectors which has a demerit of focusing on smaller objects and the problem is resolved in this paper. We programmed it with datasets of a person with helmets and without helmets and we used relays for switching on and off vehicles based on the output from raspberry pi. Our proposed model achieved 96% efficiency in detecting persons with and without helmets.*

Keywords— Helmet, Object detection algorithm, Raspberry pi, Design, Analysis

1. Introduction

1.1 General

According to the World Health Organization (WHO) reports, India is prone to road accidents and most of the cases are two-wheeler accidents. Hence to provide a safety and security system for bike riders we came up with a solution which is rider safety measures using raspberry pi. The device which checks helmet is properly worn or not.

According to the survey made by Transportation Research & Injury Prevention Programme-Road Safety in India Status

Report 2020, Motorized Two Wheeler (M.T.W) owners are increasing rapidly day by day, this leads to heavy traffic creation and road accidents. India recorded 3,54,796 cases of road accidents during 2020 in which 1,33,201 people died, In this 29.82% of people lost their lives because of not wearing a helmet.

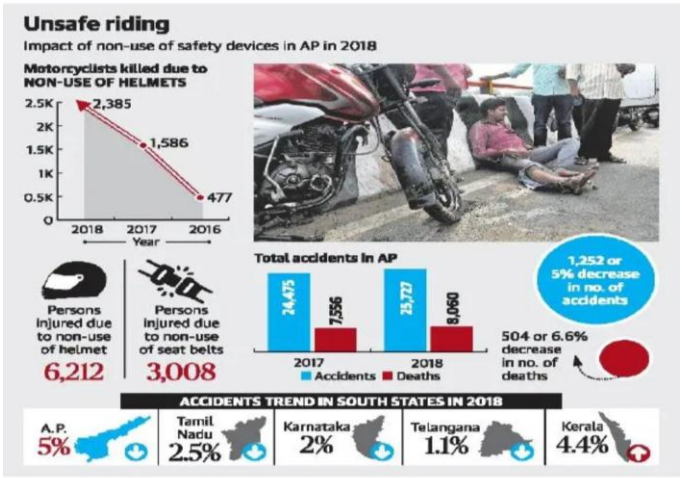

Fig-1: The Hindu Article depicting survey of road accidents

According to the report titled "Road Accident Analysis in Tamil Nadu March 2019", out of the 978 persons killed in the accidents involving two-wheelers, 508 riders and pillion riders did not wear helmets. "About 52 percent of the death in two-wheelers occurred due to non-wearing of helmets".

Month	2-wheeler deaths	Deaths due to non-wearing of helmets
January	368	174
February	318	161
March	292	173
Total	978	508

Chennai: According to the report titled "Road Accident Analysis in Tamil Nadu March 2019", out of the 978 persons killed in the accidents involving two-wheelers, 508 riders and pillion riders did not wear a helmet. "About 52 per cent of the death in two-wheelers were occurred due to non-wearing of helmets," it said.

Fig-2: Article depicting survey of loss of lives due to road accidents

To avoid such a problem, The Government of India made many awareness programs and rules, to make helmet mandatory for two-wheeler users even though many of us fail to follow these rules and regulations. Hence to make helmets mandatory for riding in two-wheelers we make a prototype work which is an automatic helmet detector. The major reason why we are not using helmets is because of carelessness. To overcome this we made an automatic helmet detector that analyses whether the person wears a helmet or not. If the person wears a helmet then the device will allow him to switch on his vehicle if he doesn't wear a helmet device will not allow him to switch on his vehicle and it will glow a red LED as a warning to the rider which will remind them to wear a helmet.

Once they wear a helmet, the device will repeat the process again for helmet detection once the rider satisfies all the conditions the buzzer will glow green and allow him to ride the bike.

1.2. Motivation

There are so many reasons behind not following the traffic rules properly, even though the government keeps on insisting we follow by raising fine amounts and punishments, we are neglecting them. The major reason for our negligence is our day-to-day stress, according to a survey, 40% of our population failed to think of wearing helmets due to their busy schedule. And 30% of people were avoiding helmets since they are traveling less distance (for example going to shops, etc) which was pure carelessness, we cannot predict when will accidents happen and what will happen next so it's our sole responsibility to save ourselves in any situation.

This is what motivated us to design a device that will allow the person to ride a bike only if he wears a helmet, so the people who fail to think of wearing a helmet will be reminded as well as those who travel smaller distances will also mandatorily wear a helmet. Hence we can save lives by implementing this device on every motor bike.

1.4 Literature Review

By researching this model, what we have found is, most of the authors preferred object detection algorithms such as SSD, CNN, YOLO, etc, for image recognition which proved to show high accuracy in object detection. In hardware, for helmet detection, they used a pulse rate sensor that analyses the vibration thereby confirming the presence of the helmet.

They also implemented alcohol detection which is done by sensors such as MQ3 which will analyze the breath of the rider thereby it confirms the presence of alcohol, if the rider was identified with consumption of alcohol then the device will not allow him to ride his vehicle, as well as vibration sensors are used to detect accidents and the location of the vehicle will be sent to saved contacts through GPS and GSM modules placed in the helmet.

In some of the papers, they used CCTV cameras which is placed in public places, and traffic signals to find people who were not following the traffic rule. They used SSD which is known as Single Shot Multibox Detector for image recognition. Using this software they can get information about the speed of the vehicle, information about the owner by scanning the number plates, etc. This is currently in use by the police department which is very much useful to track vehicles and noting down who was misbehaving and violating the traffic rules.

2. Existing Model

- Existing model consists of two IR sensors which are separated by a certain distance
- If a person wears a helmet there will be a signal breakage between the sensors by analyzing that signal, the system will come to a conclusion about whether the person wears a helmet or not.
- This model has several drawbacks as it should have a battery to be connected to the helmet and all circuits and sensors are to be mounted in the helmet which causes discomfort to the person. In our model, we have overcome this disadvantage as we are using only the object detection algorithm, so there is no need of mounting any boards or sensors in the helmet. So there will be no comfortability issues for the person who drives.
- This model has a transmitter and receiver part where the transmitter part will be in the helmet and it consists of IR sensors and an RF transmitter and receiver where the receiver part will be located in the bike near the key circuit and this part will consist of RF receiver and Arduino board.
- And in this existing model there is no possibility of changing the helmet since all the circuit boards are mounted in it whereas in our model there is no such problem. We can use whatever helmet we were comfortable with it.

2.1 Issues in the Existing Model

1. This model requires batteries to support the working and these batteries are to be placed in the helmet which may cause harm to the person in case of rainy situations
2. The biker cannot change his helmet since the receiver cannot detect signals from other transmitters due to frequency variation and the cost

of setting up those circuits in another helmet is high also frequency may vary depending on them

3. Even small damage can create a malfunction in helmet detection since all the components are just embedded so, in case of any accidents, it will cause serious damage to the circuit which may affect its function.

4. These are the demerits to look upon and these demerits were rectified in our model.

2.2 Innovation

- The existing system has its circuit board and sensors mounted on the helmet as we cannot change the helmet as we wish.
- In our device we used a raspberry pi board which acts as a minicomputer and takes input as Images from the camera which is connected to it
- After analyzing those images it will send an output to the relays which will act as a switch to the key circuit and it will allow the person to switch on his bike only if he wears the helmet else it will glow the buzzer for indication.
- In this model there is no need to mount a circuit board in the helmet the rider can wear any type of helmet and there is no risk for riders even in rainy conditions as we are using only the image recognition system and the raspberry pi board will get its power from the battery located in the bike.

3. Proposed Model

3.1 Block Diagram

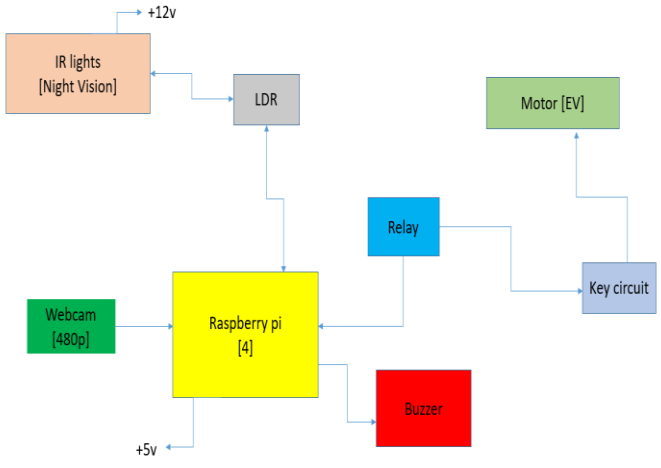

Fig -3: Block Diagram of the proposed model

Once the rider sits in his vehicle the camera placed in the vehicle will automatically scan for a human face. If the human face is detected the image will be sensed by raspberry pi which is programmed with datasets of the person with and without a helmet then the image recognition will happen.

After image recognition, if the rider satisfies the condition then the raspberry pi will send a signal to the relay to connect to the circuit if the rider doesn't wear a helmet the raspberry pi will send information to the relay which will disconnect the key circuit to the motor so that vehicle couldn't be used until the rider fulfils condition.

In case the rider travels at night time there will be no adequate light for image sensing so we are using UV light which will throw a flash on the rider during night time which is in dark tones.

The availability of light will be detected by Light- dependent resistor which is connected to the raspberry pi. This LDR will sense the amount of light availability and if the value is found to be decreased than the threshold value then it will make the UV light switch on for image capturing

3.2 Helmet Detection Process

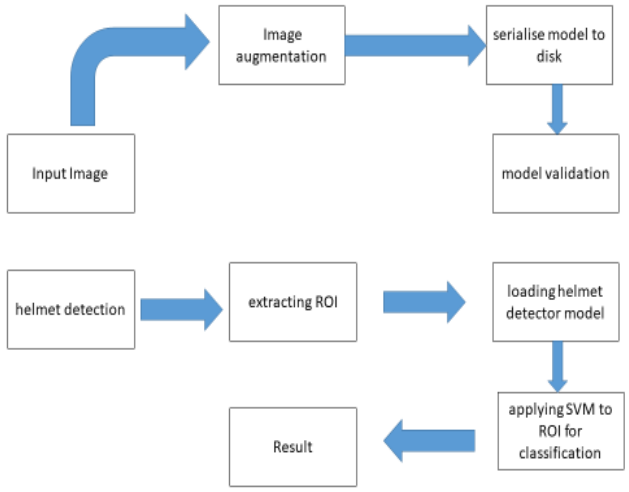

Fig -4: Flow Chart of Helmet Detection Process

The input image will be sensed and it will be augmented and the augmented image will be saved to the disk. The next process will be image validation. After validating the image the software will check for helmet detection by extracting the ROI of the image then the load detector model will analyze the image and the result will be sent to the connected parts.

3.3 Key Circuit Control

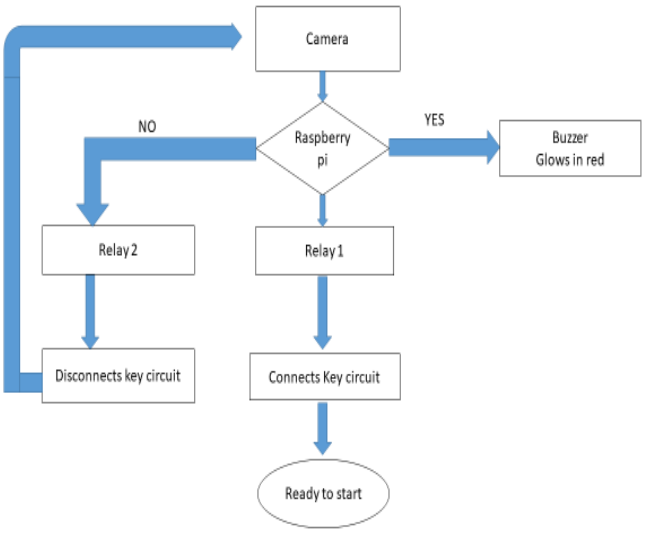

Fig -5: Flow Chart of Key Circuit Control

4. Components

4.1 Raspberry PI

Fig -6: Raspberry PI

Raspberry PI acts as a minicomputer which is useful for decision making purposes. Raspberry PI is used here to detect the presence of helmets by analyzing the images from the webcam. It runs on the Raspberry Pi OS which includes a series of GPIO (general purpose input/output) pins for controlling electronic components for physical computing. People use it to study and solve challenges because it is low-cost and high-performance. In terms of results:

a) Processor – Quad-core 1.5GHz @64-bit SoC

b) RAM: 4GB LPDDR4 SDRAM

It can also be used to bring supercomputer tech through its paces.

4.2 Webcam

The Raspberry Pi Camera Board connects directly to the Raspberry Pi's CSI connector. It can capture a simple 5MP image or a 1080p HD video at 30 frames per second. The module connects to the Raspberry Pi via a 15-pin Ribbon Cable to the dedicated 15-pin MIPI Camera Serial Interface (CSI), which was developed specifically for camera interfacing. The CSI bus can handle extraordinarily high data speeds and only transports pixel data to the BCM2835 processor.

The Pi cam board itself is small, measuring approximately 25mm x 20mm x 9mm and weighing just over 3g, making it ideal for smartphones or any other application where the question is the size and weight. The camera has a native resolution of 5 megapixels and an onboard fixed-focus lens. The camera can capture static photographs with a resolution of 2592 x 1944 pixels, and it also supports 1080p @ 30fps, 720p @ 60fps, and 640x480p 60/90 video shooting. Raspbian, the Raspberry Pi's favorite operating system, now includes support for the webcam.

4.3 Relay

Fig -7: Relay

A relay is an electrically operated switch. It consists of a set of input terminals for single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts; or combinations thereof.

Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. Here relay is used in such a way that, If the condition is satisfied by raspberry pi then it will send a signal to the relay to make contact to the key circuit thereby it allows to switch on the vehicle If the condition is not satisfied relay will break contact so user cannot switch on his vehicle unless the condition is fulfilled.

5. Result

Once the rider sits on his vehicle the camera placed in the vehicle will automatically scan for a human face. Once the

human face is detected the image will be sensed by raspberry pi which is programmed with datasets of a person with and without helmets then the image recognition will happen.

After the image recognition process, the program will check if the rider satisfies the condition or not then the raspberry pi will send a signal to the relay to connect to the circuit if the rider doesn't wear a helmet the raspberry pi will send information to the relay which will disconnect the key circuit to the motor so that vehicle couldn't be use until the rider fulfills condition.

This the very crucial part of this device which was successfully executed and the rest will be carried over by hardware components which is connected to the raspberry pi.

6. Prototype

Fig -8: Prototype of Proposed Model

This is the prototype of our device which consists of a camera, raspberry pi, etc

7. Future Scope

The device we made will detect whether the person wears a helmet or not. In the future, it can be further improved by implementing alcohol-detecting sensors such as MQ3 to avoid drunken driving which is the major reason for road accidents and it can be further enhanced by implementing GPS and GSM modules in the device which can be used to track the location of the rider.

Using IoT we can connect the device to smartphones and thereby we can track the location of the rider. The device will send information about the rider consisting including location, alcohol consumption, etc to the saved contacts.

The device can predict accidents by using vibration sensors which are placed in the helmet, using this we can detect the occurrence of accidents and the device will share the location of the rider to the nearby hospitals and preferred contacts which can save a life in case of worst situations.

The device will capture the image of the person who sits in the vehicle and it will send it for image sensing. This device can also be used to control bike thefts since the device will record the image of the person there is a possibility to find the person who involves in such activities.

8. Conclusion

The Device has been tested successfully and the technology is easy to install in any type of bike and it won't cause any harm or discomfort to the rider. However, there are some demerits such as in the case of traffic there is a problem with detecting the face of the rider since there will be a lot of persons in the crowd.

And the other thing is processing time, the device should be capable to take over the process at the maximum of within 1 minute which is the major thing to focus on. Our model will take 50 seconds on average to finish the process.

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