AN INTELLIGENT SMARTPHONE BASED APPROACH USING CLOUD COMPUTING AND IOT FOR RISK-FREE DRIVING

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Abstract : An intelligent Smartphone based approach using cloud computing and IoT for risk-free driving that will collect data using smart phone's GPS sensor, Accelerometer sensor and inform the driver about the condition of the road. The Android based application which will collect model inputs (longitude, latitude, and speed, acceleration data of vehicles) from a vehicle and send it to its nearest IoT-Fog server for processing the data quickly. It uses affinity propagation clustering approach which finds the location of road anomalies and accident prone area. It also provides a mechanism where the smart phone camera detects the driver's eyes using OpenCV to diagnose where he's in a dizzy state or not. This information will be stored in cloud for further use. With real-time analysis and auditory alerts of these factors, we can increase a driver's overall awareness to maximize safety.

IndexTerms **: Smartphone, IoT, Fog, Cloud, Affinity Propagation clustering, Bumps/speed-breaker, OpenCV, Dizzy state detection**

I. INTRODUCTION

In the present era vehicles have become an essential part of our life. But because of poor handling they have become a death angel for human life. Therefore safe driving becomes an important urge in life. Safe driving not only assures less time for driving but also it secures an accident-free drive. Though the risk in driving cannot be eradicated completely but it can be reduced. This is possible when the driver knows the road condition in advance. There are various road conditions due to which the Vehicle may fall unexpectedly leading to accidents with huge loss. The various road conditions include potholes, speed-breaker, etc. this system mainly focuses on detecting road accident using different machine learning algorithm and big data processing. After detecting the road conditions it plots them on the Google map to indicate the driver. It uses Affinity propagation clustering approach for training data and Random forest classifiers for validation of testing data. it mainly focuses on safe driving that is established on an *IoT*-based system. The *IoT* (Internet of things) based system refers to a system of internetworking connected devices embedded with actuators, sensors and network connectivity that enable these devices to collect and exchange data. An *IoT* system has been developed to detect road anomalies, accident-prone location and the driver's dizzy state. This is used for warning the drivers if there are any pothole, Bumps, speed-breaker and the accident prone area in their route. This *IoT* system also includes a fog based decision-making system. The fog refers to an architecture that provides services for computing, storing, and networking between the edge of the devices rather than routing everything through a central data center in the cloud. For calculating process clustering is need. Clustering is an Algorithm that is used to separate similar data points into intuitive groups. To arrange the regular data and irregular data it uses clustering .Fog has limited memory to store data. That's why it uses the cloud to store data for further use. Cloud refers to Internet-based computing which provides shared Computer processing resources and data, to the computer and other devices on demand .Here, the cloud is necessary to sync fog information with the cloud. The camera in the smart phone constantly focuses on the eyes of the driver and detects them using OpenCV. If the eyes are found close for more than 5 seconds, then an alarm will be raised so that the driver gets alerted. The presented work takes into account various factors leading to unsafe driving and presents a technique for evaluating the driving condition in advance.

II. LITERATURE SURVEY

In [1], it discusses the various data processing algorithms that are used to detect irregularity on the road using a mobile system. It also gives the optimal parameters and recommendations for the algorithm.(mednis 2011).In [2] ,the GPS sensor and accelerometer is used to gather the data about driving behavior and road anomalies and this data is analyzed based on a fuzzy system. In [3], the authors propose a Wi-Fi based architecture for pothole detection which gives prior warnings to the driver in case of detection of a pothole. The system consists of access points which are placed on the roadsides which broadcast the data which is then received by the Wi-Fi enabled vehicles as they enter the area covered by the influence of the access points. The mobile nodes can also broadcast their response as feedback which when received by access point can be utilized for backend server processing. In [4], the authors develop a pothole detection system using 2D LiDAR and Camera. 2D LiDAR is used to find the distance and angle information of the road. The pothole detection algorithm and image-based pothole detection method is used to improve the accuracy of pothole detection and to obtain pothole shape. In [5], it uses an efficient unsupervised vision-based method for pothole detection without the need for training and filtering. It firsts detect asphalt pavements by analyzing RGB color space and performing image segmentation. A data set consisting of selected images from Google search engine is used which contains highly unstructured images taken from different cameras and shooting angles. The method uses manipulation of B component in RGB space and image segmentation it can be easily and widely adopted for hardware implementation. In [6] image pre-processing based on difference of Gaussian-Filtering and clustering based image segmentation methods are implemented for better results. The K-Means clustering based segmentation was preferred for its fastest computing time and edge detection based segmentation is preferred for its specificity. In [7], it develops a crowd sourced system to detect and localize potholes in multi-lane environments using accelerometer data from embedded vehicle sensors. This crowd sourced system reduces the required network bandwidth by determining road incline and bank angle information in each vehicle to filter acceleration components that do not correspond to pothole conditions. In [8] it proposes a smartphone-based driver assistance system which uses front and rear camera image recognition to help maintain the safety of the driver. The system uses a front camera image to detect the drowsiness of the driver, and a rear camera image to detect the vehicle in front. In [9] it describes an application called “Driver drowsiness detection” and the purpose of this application is to alert drivers so that they can be cautioned to pull over and stop driving in a drowsy state. It utilizes Haar-cascade Detection as well as template matching in OpenCV to detect and track the eyes using the front camera of an Android device. In [10], it proposes an eye blink monitoring algorithm that uses eye feature points to determine the open or closed state of the eye and activate an alarm if the driver is drowsy. By applying the Viola Jones algorithm we successfully detected the face region, Once the face is identified, the Region of Interest (ROI) is set to the face rectangle, detected by the Viola Jones algorithm. On this region again the Viola Jones Cascade classifier is applied to detect eyes. An accuracy of 94% has been recorded for the proposed methodology. Figure 1 shows the survey of the accidents that caused due to bad road conditions such as potholes, speed-breakers and the drowsiness of the driver.[12-15]

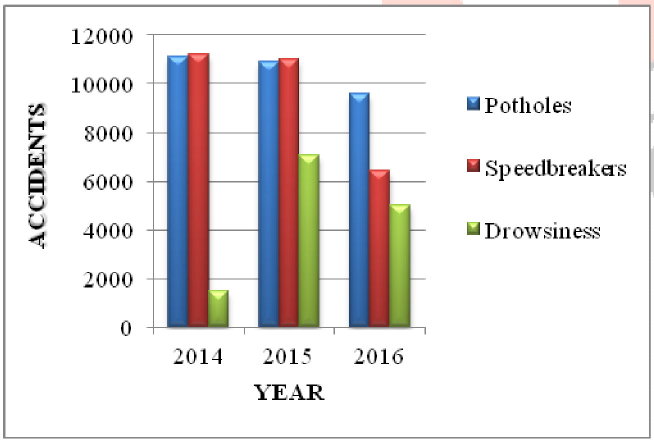

FIGURE 1: Survey of accidents caused due to bad road conditions and drowsiness

III. PROPOSED SYSTEM

The essential focal point of this framework is to identify the different street abnormalities well ahead of time and caution the client to guarantee chance risk-free driving. It requires an advanced mobile phone which keeps running on the Android working framework with inbuilt GPS sensor, Accelerometer sensor, and internet. The smart phone is placed in the car. Figure 2 represents the design of the model. The GPS of the advanced mobile phone gathers the constant area of the gadget. The speed of the car is ascertained by GPS and moving time. The accelerometer sensor has 3 axes. The estimation of x-pivot changes when the device is moved left or right. The estimation of y-pivot changes when the device is moved forward and backward. The estimation of z-hub changes when the device is moved up and down. It needs the z-hub esteem for separate potholes, speed breaker. The device is set in the car on a level plane for getting the exact information for z-pivot. Each gadget is associated with the haze. Here we are utilizing fog since it tackles the issue by keeping information nearer to the nearby PCs and gadgets, instead of directing everything through a central server in the cloud. Thus, the information exchange is speedier than the cloud and we will get the outcome rapidly. These gadgets are sending Latitude, Longitude, speed, and accelerometer information to the fog constantly. The fog forms the information and sends the outcome to each cell phone and each fog. Fog has memory impediment that is the reason it likewise sends the outcome to the cloud to store data for additionally utilize.

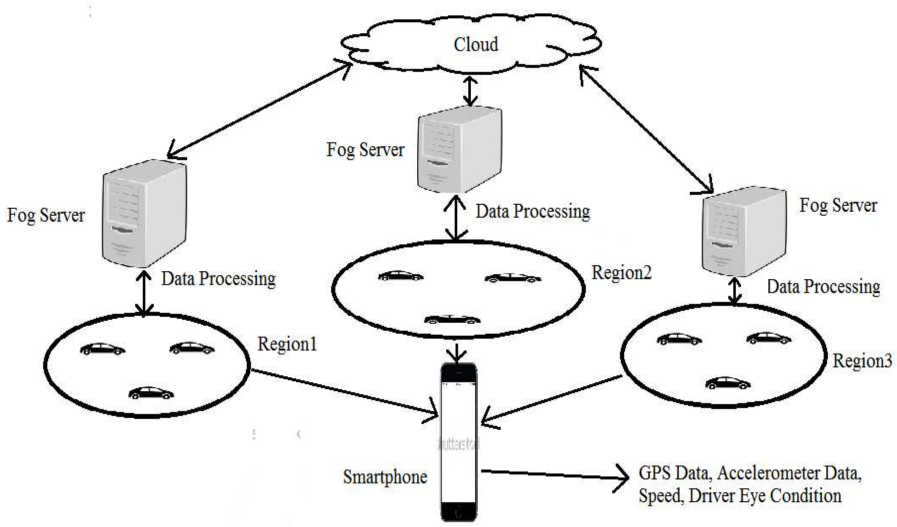

FIGURE 2: Design of the Model

A. Detecting different road anomalies

The information is sent to the closest fog from the advanced mobile phone each λ times. Here, λ is diverse time interim as indicated by various types of vehicle. At that point the information is computed to discover street oddities. If there is a pothole or speed-breaker, at that point each vehicle will back off on that area, and subsequent to passing it, the car will accelerate once more. Thus, for a specific zone if every one of the vehicles stoppages and speed ups again then haze will choose that there is a pothole or speed-breaker. For isolating speed-breaker and potholes, it will assess its z-pivot information. On the off chance that the z-pivot esteem is not as much as lower z-hub limit esteem then it is a pothole, if the z-hub esteem is higher than upper z-hub edge esteem, at that point it is speed breaker.

Algorithm 1*: Detecting pothole and speed breaker*

INPUT:

Sc: speed of current row
Sp: speed of pervious row
Sn: speed of next row
St: threshold speed
Sw: speed of the line after next row
Z : accelerometer z-hub estimation of current row
Zmax: most extreme edge for accelerometer z-hub
Zmin: least limit for accelerometer z-pivot

OUTPUT: *Location of the pothole and speedbreaker*

1. Fog database is read
2. while end of row do
3. if (Sc < Sth AND Sc > 0) AND (Z <= Zmin) And (Sp > Sc) AND (Sn > Sc) then
4. Save location of current row as pothole
5. end if
6. if (Sc < Sth AND Sc > 0) AND (Z >= Zmax) And (Sp > Sc) AND (Sn > Sc) then
7. Save location of current row as speed-breaker
8. end if
9. end while

B. Detecting accident prone areas

For finding accident prone area, it uses the previous data of accident. The data is collected from Accident Research Institute (ARI), BUET. This data holds some total accident in each area. For clustering these data, we again use Affinity propagation clustering algorithm.

Algorithm 2*: Detecting accident prone areas*

INPUT:
Thm: *Threshold for moderate accident area*
Thh: *Threshold for highly accident area*
An: *Number of total accident in individual area*

OUTPUT: *Location of accident prone area*
1. *Read all row from cloud database*
2. while *End of row* do
3. if (*An*>=*Thm*) AND (*An* < *Thh*) then
4. *Saving location of current row as moderate accident area*
5. end if
6. if *An* ≥ *Thh* then
7. *Saving location of current row as highly accident area*
8. end if
9. end while

Algorithm 3 *: Affinity propagation*
r(i, k) ← s(yi ,yk) − maxk|k=k{a(i, k) + s(yi , yk)} →(1)
a(i, k) ← min { 0, r(k, k) + i|i∈{i,k} max{0, r(i , k)} →(2)
1. Initialize availabilities a(i, k) to zero ∀i, k
2. do {
3.Update, using Equation (1), all the responsibilities given the availabilities
4. Update, using Equation (2), all the availabilities given the responsibilities
5.Combine availabilities and responsibilities to obtain the exemplar decisions
6. } until Termination criterion is met.

C. Detecting dizzy state of driver

The camera in the smart phone constantly focuses on the eyes of the driver and detects them using OpenCV. If the eyes are found close for more than 5 seconds, then an alarm will be raised so that the driver gets alerted. This system uses a front camera image to maintain driver safety. This system detects the driver's drowsiness by processing a front camera image, and alarms the driver. First, the face and eyes need to be detected from the front camera image in order to detect the drowsiness. The face and eyes can be detected by using Haar-like features. Face detection should come first to decrease the eye detection time by setting the region of interest (ROI). Second, drowsiness should be judged from the detected eye image it separates the eye image into white pixels that indicate the skin area and black pixels that indicate the eyeball area. It can be considered that the eye is closed if the number of black pixels decreases to less than 80% of the number of whole pixels according to PERCLOS (percentage of eye closure), and that the drowsiness is detected if the eye is closed for longer than 400ms . It can judge whether or not the driver is currently drowsy by checking these conditions in the front camera image.

IV. RESULTS

This section illustrates the output of the system. FIGURE 3 shows the screenshot that appears on the user interface on the Smartphone, where the driver can enter the source and destination of their journey. Here the current location of the driver can be selected as a source by clicking at the check box. The red flag indicates the source, green flag indicates the destination and the blue line indicate the path. The blue dot shows the current location of the user.

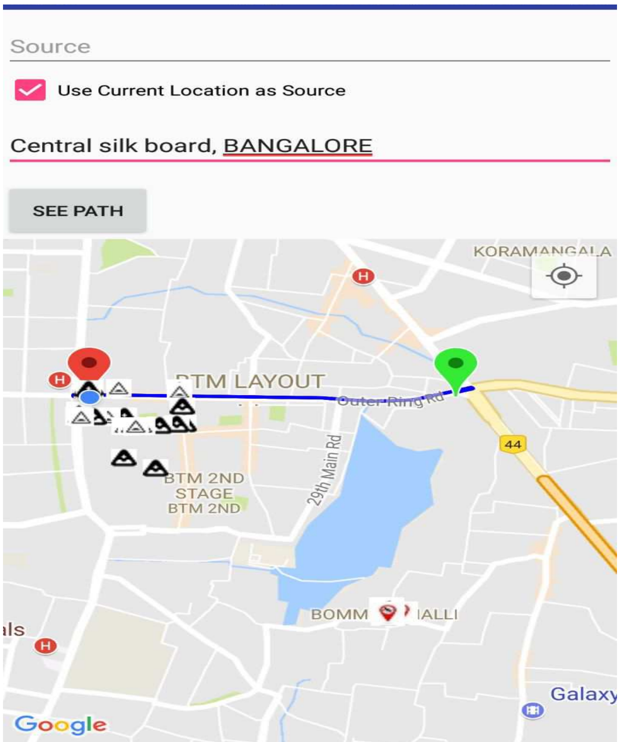

FIGURE 3 : User interface with entered source and destination

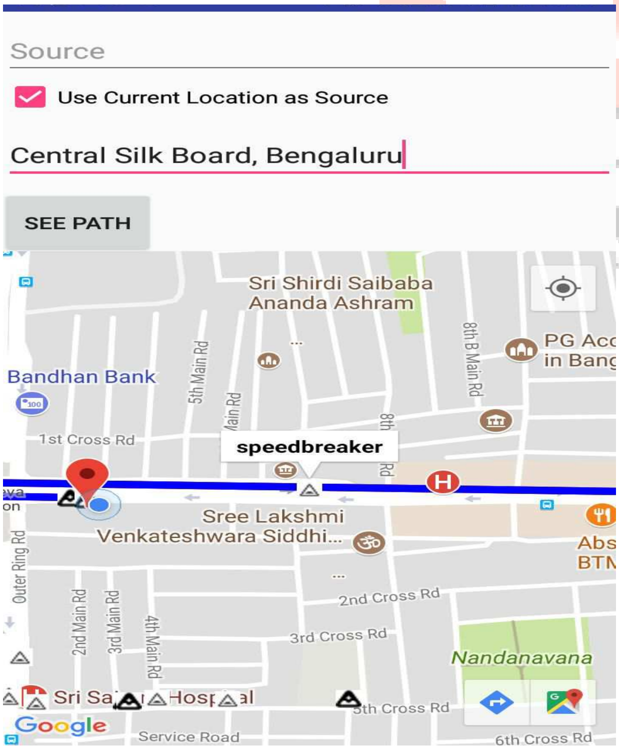

FIGURE 4: Spotting speed-breaker

The grey triangle in the FIGURE 4 indicate the speed breaker in the path, whenever the driver approaches the speed breaker, the application will give an indication of the approaching speed breaker with the help of voice alerts stating the distance of the speedbreaker from the drivers location.

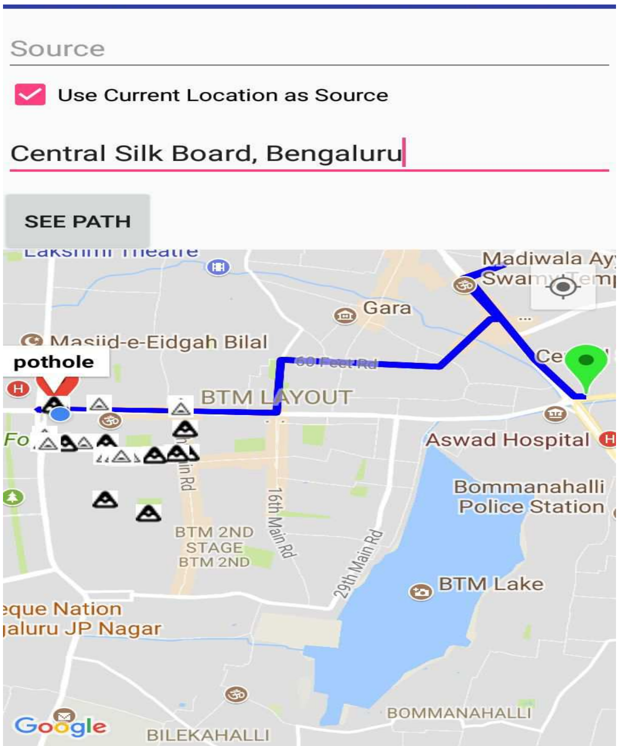

FIGURE 5: Spotting pothole

The black triangle in FIGURE 5 indicate the pothole in the path, whenever the driver approaches the pothole, the application will give an indication of the approaching pothole with the help of voice alerts stating the distance of the pothole from the drivers location.

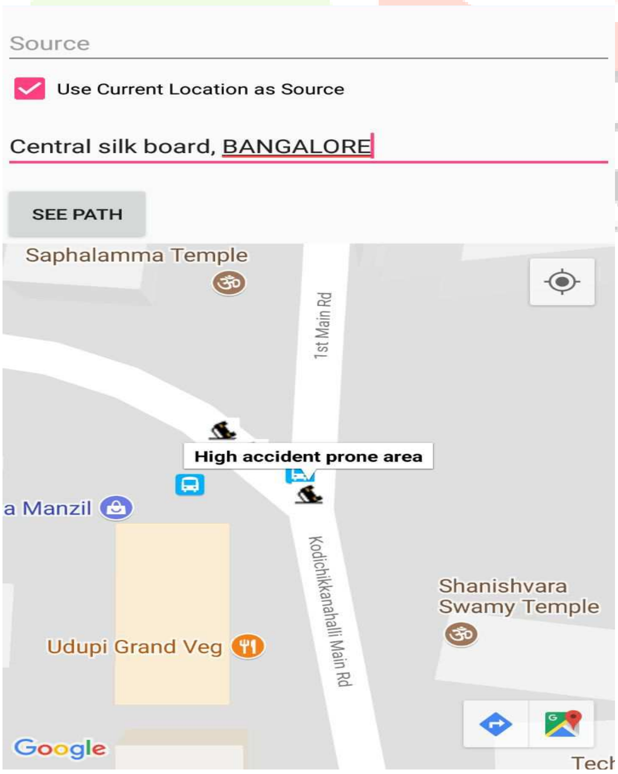

FIGURE 6: Detection of high accident prone area

The FIGURE 6 indicates the highly accidental prone areas .so when the user approaches these areas the user gets an alert so that the driver reduces their speed in order to avoid accidents. The notification to user will be in the form of voice alerts.

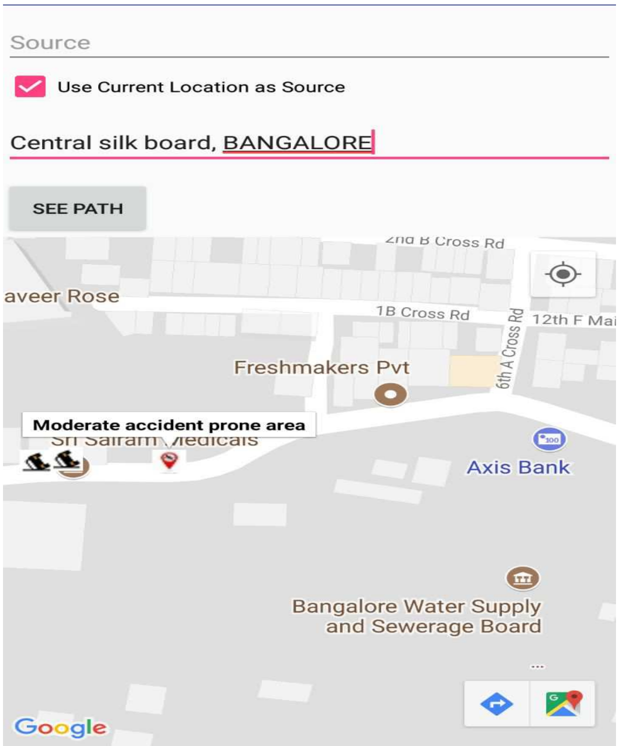

FIGURE 7: Detection of Moderate accident prone area

The FIGURE 7 indicates the moderate accident prone area. When the user approaches these areas the user gets an alert so that he reduces his speed in order to avoid accidents. The notification to user will be in the form of voice alerts.

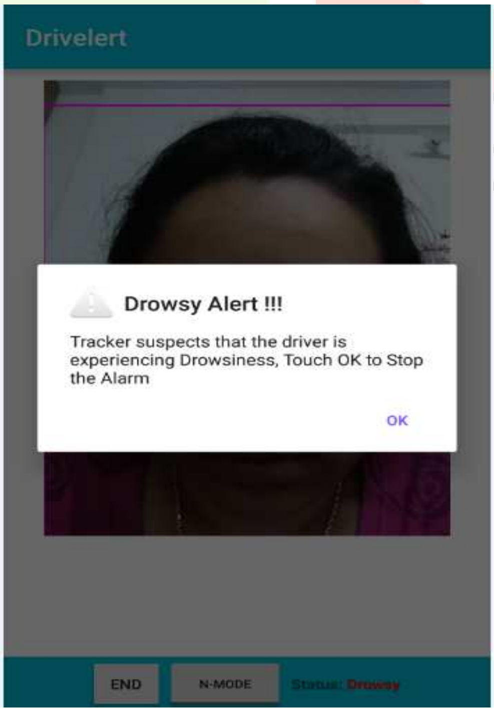

FIGURE 8: Drowsiness detection

Figure 8 detects the eyes of the user to indicate whether the driver is in dizzy state or not. In the above picture the Closed eyes is detected hence it produces an alarm to awaken the driver.

V. CONCLUSION

Road accidents can't be eradicated totally, however it can be controlled by demonstrating the state of the street to the vehicle driver. Consequently safe driving ends up a standout amongst the most regular desires in urban and in addition country life. Safe driving not just secures a mishap free drive it likewise guarantees less time for driving. In spite of the fact that driving can't be without hazard, one ought to know about the street conditions. The model sources of data (longitude, latitude, and speed, acceleration of vehicles) are obtained using Android application to have real-time implementation. Additionally, the model incorporates two computational insight strategies that are cloud and fog based framework. It utilizes Affinity propagation clustering algorithm on training data. It likewise gives a component where the advanced mobile phone camera identifies the driver's eyes utilizing OpenCV to analyze whether they are in dizzy state or not. The advanced cell is utilized expecting to evacuate the requirement for deploying particular sensors in a vehicle or at any street intersections. However, the essential goal of this approach is to have the capacity to give a continuous observing framework that can guarantee safe, accident-free and fast driving.

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