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Estimation of SAG using Image Processing and Monitoring of Transmission Lines

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ABSTRACT: While constructing an overhead transmission lines, it is very important that conductors are under safe tension. If the conductors are too much stretched between supports with intent to save conductor material, the stress tension in the conductor may reach dangerous value and few instances the conductor may break due to high tension. On the other hand if the conductors are very loosely held between supports then there is risk for conductor swing during heavy winds which might result in contact with other conductors .To ensure safe tension in the conductors they are usually not fully stretched but are allowed have some dip between supports which is known as sag. Sag is an important parameter and must be maintained within limit. There are many sensor based techniques where sensors are mounted directly on the wire and are used to calculate the sag and tension. But the mounting of different sensors makes it very expensive and during the deployment of sensors switching off the power line is needed. Also human involvement is very much required. This project focuses on the estimation of sag using image processing technique using matlab software. Also gyroscope sensor, contactless temperature sensor are used to detect changes in sag which is then further calculated using image processing technique using matlab. The gyroscope sensor which is fixed in the suspended insulator of transmission line, detects conductor movements due to wind. The contactless temperature sensor is used to monitor conductor temperature as sag value changes with temperature. Calculation of sag is done by a captured image of an entire span of the transmission line using a camera module, then the captured image is processed in matlab. The estimated sag value is then transmitted to monitoring stations using a GSM module so that immediate precautions can be taken as soon as possible.

KEYWORDS: Transmission lines, Sag, Tension, Image processing, matlab, GSM module, Arduino microcontroller, Gyroscope sensor, temperature sensor, relay

I. INTRODUCTION

Transmission lines facilitates the transmission of electrical power from generating stations to our homes. There are usually two ways to construct transmission lines either underground or erecting them between two supports above ground level. while erecting a conductor line between two supports sag and tension are two important parameters that must be monitored in order to avoid breakage of conductors. Any breakage in line conductors can very catastrophic, this results in expensive repair work and many dangers associated with it.So to avoid the above mentioned, Every transmission line is allowed to be placed with unique sag value. The value of sag must be accurate in order to provide safety for the conductor from not being stressed under high tension. If this sag crosses a certain critical value, then conductor Breakage and short circuit is almost inevitable. Hence, sag and tension monitoring must be done for every transmission line. conductor lines require continuous monitoring of 3 parameters sag, tension and temperature. Many factors have an significant influence on the sag. Those factors affecting the sag includes Span i.e., the horizontal distance between two poles, Wind, Temperature, Weight of Conductor, and Tension. usually to calculate the tension and sag of an overheadtransmission line, the knowledge on different parameters like temperature, current and weather are must know beforehand. The effect of wind on transmission lines can be monitored using the gyroscope sensor which is placed on the suspended type insulator of line conductor. The contactless temperature sensor monitors the line conductor temperature. Both these sensors are not directly placed on the line conductor. These sensors provide necessary information about the factors that affect the sag. However estimation of sag value through sensors is not much practical. The disadvantage of implementingsensor based sag estimation is that there is a necessity of turning off

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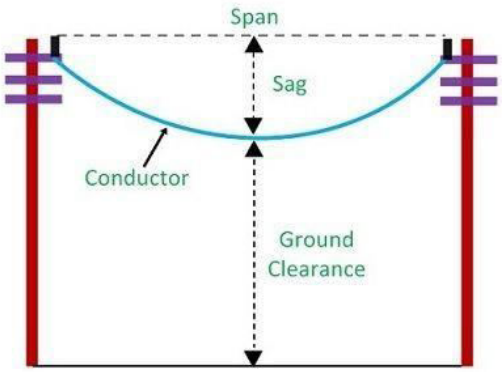
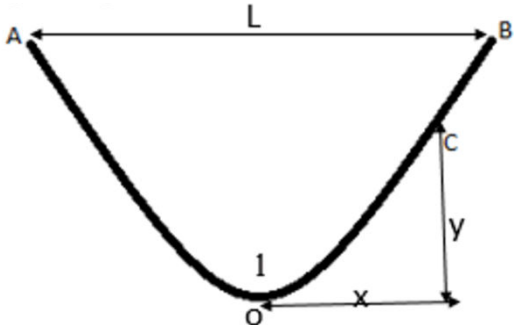
the lines during the mounting of sensors and many sensors must be used for each parameter and hence cost increases significantly. These shortcomings can be avoided by the implementation of image processing technique. Image processing is applied to find the tension and sag. The image of the transmission line span is captured by the camera module that isplaced appropriatelyin front of the transmission line. By processing the captured image into a binary format, the sag in a transmission line is found by marking certain coordinates. Then using the usual tension and sag formula the values of sag and tension can be found. The sag estimation process starts with the capturing of image using camera. It is important that the captured images contain the entire span .Many difficulties may arise during the analyzing procedure of the image characteristics. So while analysing, it is important that the background of the image must be removed. Hence, background removal is done for extracting the image of the wire separatedfrom its backgroundthus neglecting those above mentioned difficulties. The main objective of this project is to neglect the use expensive sensors for the calculating of sag. The use of the camera module to capture the image of the transmission line span and involvement of acquisition of data to get the accurate results and its procedures is explained here in this project. The needed data sets of the conductor lines used are the length of the line, span length of the conductor line, the accurate value of sag. The above mentioned values is different for each transmission line hence these datasets can be observed for analyzing the condition of different transmission lines. The whole process is done using image processing with the help of matlab software. The results of the processed image using matlab are sent to the monitoring station using a GSM module with arduino microcontroller.Accordingly ,subsequent actions are taken by the power system engineers as early as possible.

SAG AND TENSION IN TRANSMISSION



Transmission line Sag defined as the difference of level between the lowest point on the line conductor and points at which it is supported. Placing the overhead transmission lines with the desired sag is very important. If sag value is very low, then there ishigh probability conductor breakage as a result of high mechanical tension. If the sag value isvery high, then conductor swing due to wind and contact with other conductorsis inevitable .When the conductor is tightly held between



supports and tension is high, then the transmission conductor is said to be having a lower value of sag. On the other hand the conductor is held loose between supports and tension is loose, then the transmission conductor is said to havea higher value of sag. The tension and sag of the transmission line is calculatedusing these Equations.

Horizontal tension of the transmission line is given by:

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T = (W(X^2))/2Y

where X and Y are the corresponding horizontal and vertical distances from the lowest point O to the random point C , then W is the weight per length

Sag of the transmission line S = (W(L^ 2))/ 8T)

Where,
L (span length)
S (sag of the transmission line)
T (horizontal tension)

II. EXISTING SYSTEM

There are some few usual techniques to measure sag and conductor tension. The most accurate method is to perform a travelling wave timing test while the actual conductor temperature is measured at the time of the test. Then using the results of the timing test, the actual sag and tension can be determined by calculation knowing the conductor characteristics and temperature. Another method is to use a survey instrument like a theodolite to accurately record the sag while the actual conductor temperature is measured. The tension can then be determined by calculation. Note that the conductor temperature is a critical factor and has to be measured accurately. It is not simply the air temperature. The steady-state conductor temperature can be influenced by the following: internal energy of the conductor as a result of electrical current flow, radiant 'heat' gain from solar absorption and conductive 'heat' loss from cooling air blowing across the conductor and other factors. The best methods for measuring conductor temperature is to either measure the temperature of a sample of the conductor suspended in the air stream And exposed to the same solar radiation; or measure the temperature of the actual conductor. In this method we need to account for the heating effect of current flowing in the line if it is carrying
Load at the time of the measurement. The suspended conductor method will not work in that case. Only a direct measurement will work. If the line is also energized at the time of the test, there will be safety issues associated with getting too close to the line to make a measurement. Also there are many sensor based techniques which requires direct installation of sensors on the line conductor. The sag calculation is then done by analysing the sensor output values.

DRAWBACKS OF EXISTING SYSTEM

In all the above mentioned existing systems, direct human involvement is required thus cutting off the power supply is necessary. This causes unnecessary power interruption. For the above mentioned techniques to work accurate measurement of temperature in mandatory. But measuring the accurate temperature can be difficult. The conductor temperature is a critical factor and has to be measured accurately. It is not simply the air temperature. The steady-state conductor temperature can be influenced by the following: internal energy of the conductor as a result of electrical current flow, radiant 'heat' gain from solar absorption and conductive 'heat' Loss from cooling air blowing across the conductor and other factors. The best technique to get the accurate value of conductor temperature is to either measure the temperature of a sample of the conductor suspended in the air stream and exposed to the same solar radiation; or measures the temperature of the actual conductor. In this method we need to account for the heating effect of current flowing in the line if it is carrying load at the time of the measurement. The suspended conductor method will not work in that case. Only a direct measurement will work. Direct measurement can be challenging because if the line energized getting too close to it measure Temperature can be fatal. The sensor based technique is both expensive and time consuming. Also mounting the sensors requires the cutting of the power supply which again causes power interruption. The FBG (Fibre Bragg Grating) sensor is very expensive also in stallion of the sensor requires power interruption.

III. PROPOSED SYSTEM

IMAGE PROCESSING USING MATLAB

As the existing systems have numerous difficulties and drawbacks, in this project we incorporate a new method for sag estimation which image involves processing technique. The image processing is done using Matlab software. This technique starts with the capturing of entire span of transmission line. The capture image is further processed to estimate the sag value. Image rescaling is done and it is 100 pixels/metre. The first step involved is to remove the background of the captured image, so that marking the

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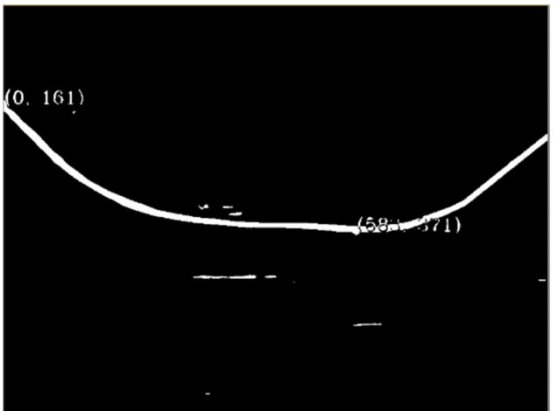
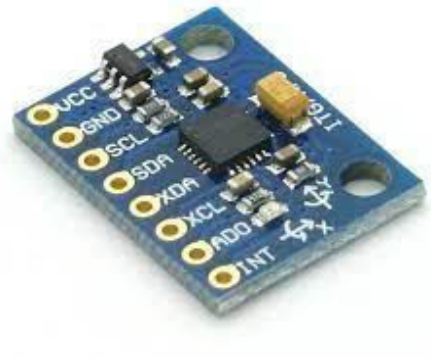
Coordinates can be done easily. The next step is to mark the lowest coordinate on the transmission wire which is necessary for sag measurement. Then a random coordinate is marked on the on the transmission wire. Then based on the below image the X and Y distance from the lowest coordinate to the random coordinate is estimated through matlab. Then the X and Y value is substituted is the usual formulas to calculate the horizontal tension T. Then T is substituted in the sag formula to estimate sag. The calculated sag and tension values are then transmitted to the concerned people through a GSM as a text message which connected with an arduino microcontroller. By using image processing technique for sag calculation we overcome the limitations of the existing system.



SENSORS FOR MONITORING PURPOSE

Additionally we use two sensors to monitor the transmission line, one is the gyroscope sensor and the other is contactless temperature sensor. The gyroscope sensor is mounted on the suspended disc insulator of transmission line and monitors conductor swing during wind, also it gives information about alterations in sag because wind affects sag. So based on the gyroscopic sensor reading the concerned person is notified to re-check on sag value. The temperature sensor provides the line conductor temperature and any abrupt changes in the temperature value notify a change in sag value, as the temperature and sag value is related. The relation between sag and temperature is that sag increases with the increase in temperature and reduces with decrease in temperature. The output of both the sensors is displayed in a 16*2 LCD display. The gyroscopic sensor provides the stationary axis position. During wind the conductor swings and the change in axis position is shown in LCD. If the change in position is very abrupt then for safety a relay is operated to cut the power supply to avoid short circuit by contact of conductors during conductor swing due to wind. Also the temperature sensor displaysline conductor temperature in the 16*2 LCD panel.



GYROSCOPE SENSOR (MPU6050)

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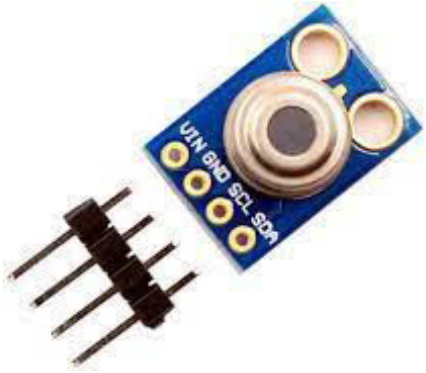
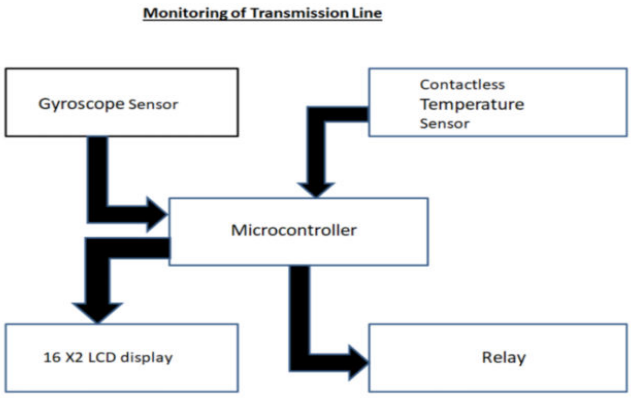
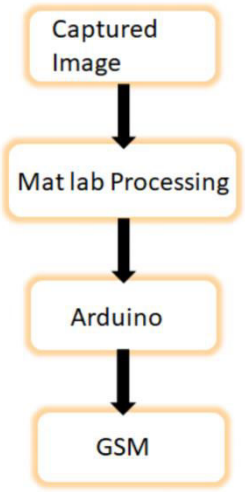


CONTACTLESS TEMPERATURE SENSOR-MLX60914

BLOCK DIAGRAM: -





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ADVANTAGES: -

- Cost factor is reduced to a greater extent when comparing with the set up of sensors where they are directly mounted on the transmission wire.
- Accelerometer sensor in line insulator and contactless temperature sensor provides early signs of abnormality thus necessitating the need for sag value checking.
- Human intervention is reduced because it is only needed when correcting the sag and while estimating the sag. the need for switching off the power supply of transmission line is avoided.
- The final value of sag can be transmitted using GSM to concerned authority so immediate steps can be taken.

IV. FUTURE ENHANCEMENTS

As one of the future enhancement this research can be used to observe dynamic line ratings of the conductor lines and the current carrying capacity of the conductor material. Machine learning and artificial intelligence can be used in the diagnosis of ice formation in the transmission line. Currently, image processing technique can be further extensively used in the observation of ice formation in the transmission line by analysing the PSNR ratio. Artificial intelligence can be widely used in analysing transmission line faults. The correction of sag and removal of icing can be done by using specially designed ground vehicle or aerial vehicle thereby reducing human involvement to a greater extent.

V. CONCLUSION

The idea of monitoring the transmission line and estimation of transmission line parameters such as sag and tension and is dealt and explained in detail using image processing in Matlab software. Calculation of transmission line parameters are carried out by capturing an image of the transmission Line using a single camera which is kept in front of the transmission line. This concept of image processing method is a bettertechnique and can be effectively used for sag and tension estimation in the transmission lines instead of mounting more expensive sensors for the same sag calculation purpose. The procedures for removing background and locating the lowest coordinate and random coordinate is discussed in detail and can be best suited for calculating the sag and tension of the transmission line. The results are then sent to the monitoring station to the concerned authority through a GSM module connected with an arduino so that immediate steps can be taken. The additional use of sensor for monitoring the transmission is useful and provides necessary information's about alterations in sag.

REFERENCES

[1] Pierre Van Dyke, Dave Havard, Andre Laneville. (2008)." EFECT OF ICE AND SNOW ON DYNAMICS OF TRANSMISSION LINE CONDUCTORS. Atmospheric Icing of Power Networks, pp. 171-228

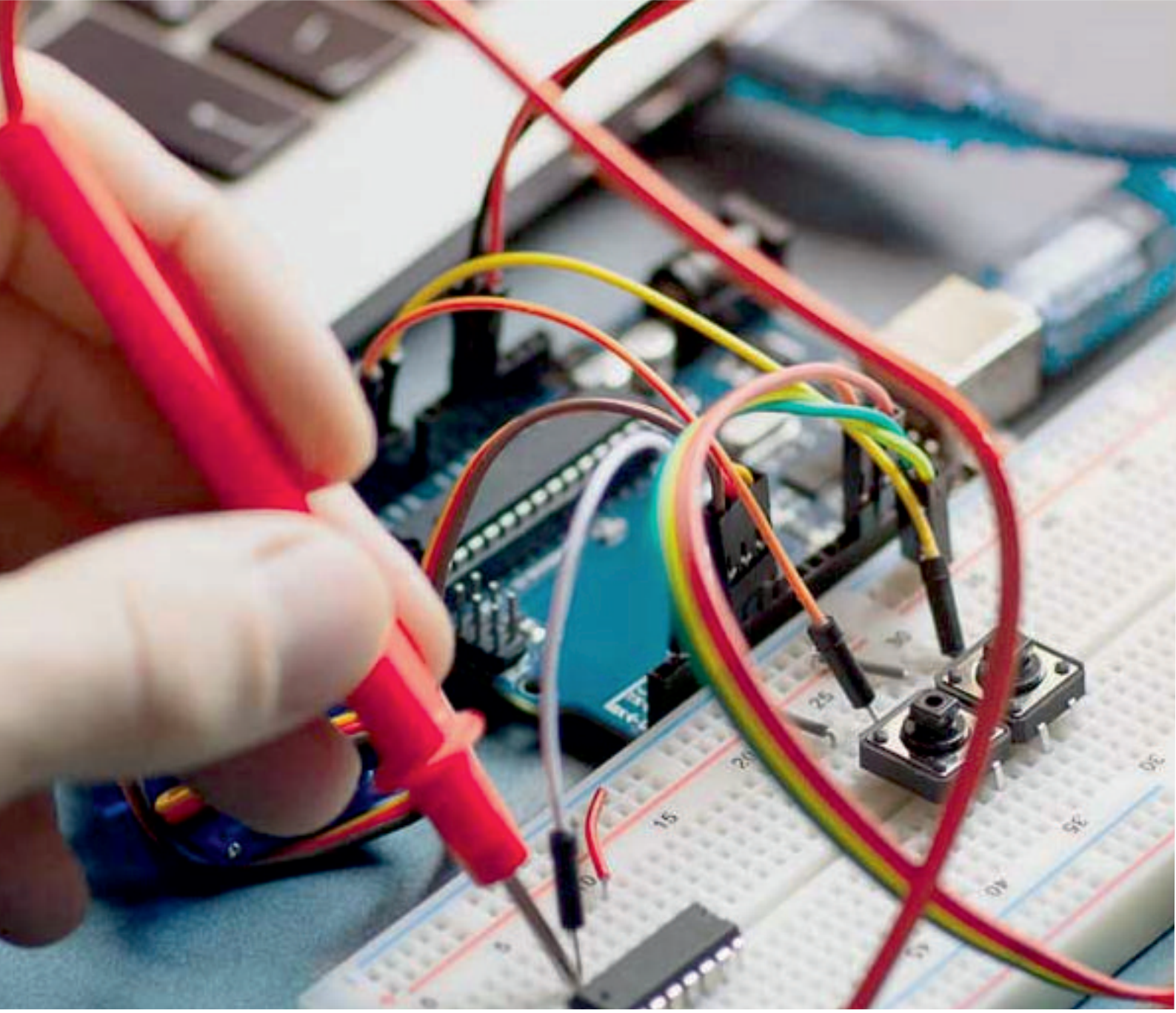
[2] MichalWydra, Pawel Kubaczynski, Katarzyna Mazur and Bogdan Ksiezopolski(2019). TIME-AWARE MONITORING OF OVERHEAD TRANSMISSION LINE SAG AND TEMPERATURE WITH LORA COMMUNICATION. Energies 2019.

[3] Jiazheng Lu, Jing Luo, Hongxian Zhang, Bo Li and Fuhai Li. (2011). IMAGE RECOGNITION ALGORITHM BASED ON THICKNESS OF ICE COVER OF TRANSMISSION LINE. 2011 International Conference on Image Analysis and Signal Processing, pp. 210-213.

[4] Xiaopeng Wang, Jianlin Hu, Bin Wu, Lin Du, Caixin Sun. (2008). STUDY ON EDGE EXTRACTION METHODS FOR IMAGE-BASED ICING ON-LINE MONITORING ON OVERHEAD TRANSMISSION LINES. International Conference on High Voltage Engineering and Application, Chongqing, China.

[5] Chunsheng Yu &Qingjin Peng. (2010). ICING DETECTION USING IMAGE-BASED 3D SHAPE RECOVERY.ComputerAided Design and Applications,Vol. 7, No.3.

[6] S. Singh and R. Singh. (2015). COMPARISON OF VARIOUS EDGE DETECTION TECHNIQUES.



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