



Analyzing the Purity of Gold through Mobile Apps

M. Banu¹, C. Mary Merline Rani², Harshitha Prakash³

1. Assistant Professor, St. Joseph's College (Autonomous) Bangalore

2. Assistant Professor, St. Joseph's College (Autonomous) Bangalore

3. Student, St. Joseph's College (Autonomous) Bangalore

ABSTRACT

Bountiful advanced digital methods are needed for quick, instant and exact finding of purity and reliability of precious metals like gold. The purity of gold can be determined by using the hand held device like smart phones. This paper focuses on implementing an advanced image processing technique (MATLAB) that is integrated into a hand held device through mobile apps. Through this method we can identify the purity of gold in simple steps. The major advantage of this effective method is its instant and simple digital approach that can be used by hand held devices such as smart phone and other PDA (Personal Digital Assistant). It helps both the purchaser and the vendor of Gold metal or ornament. This approach helps to identify the purity of Gold that helps to know the cost and worth of the Gold according to the result obtained after analyzing the purity of gold.

Key Words: purity analysis of gold, mobile apps, MATLAB.

INTRODUCTION

There are numerous digital methods to analyze the quality of various metals. The most valuable metal Gold is moulded for the ornament. As the usage of Gold is increasing it made the way for the merchant to mix the other metal with Gold metal. This made the customers difficult in identifying the purity of gold. To analyze the purity of Gold various researchers have proven different digital technology that can grade the purity of Gold. Most of the methods used are based on image processing technique. The study on this paper emphasis on enhanced method that can be used by the customer with the help of hand held devices such as smart phone. The method focuses on implementing an advanced image processing technique (MATLAB) that is integrated into a hand held device such as smart phone and other Personal Digital Assistants. The method will help both merchant and customer. This suggested method of image processing through mobile apps can be used as tools to identify the purity in a simple way. There cannot be any mishandle in judging the purity of Gold.

Image Analysis and Strategies

The focus of image analysis is to derive features and data related to image into quantitative information that is helpful to analyze the quality of Metal. The General strategies for image analysis are:

1. The image analysis involves in acquiring digital image using a powerful device that capture good quality of image. This image acquisition can be achieved through devices such as digital camera, the obtained image is subjected to remove irrelevant and imperfections that causes noise at low light levels, uneven illumination etc. The image perfection is important to enhance the features of image that make easy to analysis and get accurate values for the subsequent analysis.
2. The enhanced image is ready to derive the relevant features. The feature or values of images can be obtained by using image processing applications such as MATLAB. The various tools provide in MATLAB application and implemented to extract the features from the image. The various tools that can be used are morphological image processing and image segmentation that can be used for analysis the image.
3. The obtained features of the image with help of MATLAB is analysis. The analysis of image is to compare the features of image with the original values of good and 100% pure image. The obtained difference after the comparison is used to classify the quality of image.^[1]

LITERATURE REVIEW

The study of the paper “Identification of original gold using Digital Image Processing” is Gold contents can be measured using X-Ray Fluorescence (XRF) Technique, which is faster and non-destructive. XRF method gives very efficient solution. But XRF spectrometers and Karat meters are not available in all the places because they are very expensive. This system incorporates to identify the gold objects is the statistical method based on Digital Image Processing using MATLAB. In the statistical method, it uses Statistical Parameter Estimation where a set of parameters is compared with the predefined parameters and with the help of tolerance matching technique one can identify the gold objects among several gold objects. When we place the ornament in the machine’s plate it gives an information about the metals which are used in making the ornaments, what are the percentages used and carat of the ornament within 30 seconds. This is the advantage of this method.^[2]

The research paper “Electrospray Mass Spectrometry for Mycotoxin Detection and Purity Analysis” emphasis on Gas Liquid Chromatography (GLC) is used to separate a different mycotoxin types(i.e) trichothecenes, zearalenone, patulin, and anthraquinones. But mycotoxins yield high performance liquid chromatographic (HPLC) separation. Frisvad and Thrane developed a general reversed-phase HPLC analysis procedure for simultaneous separation and detection of different mycotoxins and other fungal metabolites. This method is very flexible

approach to separate mycotoxins. Some recently identified mycotoxin classes are good to HPLC separation, UV chromophores are not required for detection using this method.

For these toxins, HPLC analysis is used another method for the detection step. Electro spray ionization (ESI) mass spectrometry (MS) is the good one for mycotoxin analysis, especially for the larger and less volatile toxins not amenable to gas chromatography (GC) and particularly for the fumonisins and AAL toxins lacking strong UV chromophores. Moreover ESI is an ionization method developed in response to the need for direct MS characterization of HPLC separated components.^[3]

ORIGIN OF THE RESEARCH

The history of Gold ornaments can be traced back over 3000 BC and gold jewellery was found in the tombs of Tutankhamen. Jewellery has been a part of Indian civilization for many centuries. Gold ornaments have been discovered that date back as far as the Harappa and Mohenjo-Daro civilizations, thousands of years. And they crafted unique jewellery making style and Gold is also used in thread and in embroidery.

Great human achievements are frequently rewarded with gold, in the form of gold medals, gold trophies and other decorations. Winners of athletic events and other graded competitions are usually awarded a gold medal. Many awards such as the Nobel Prize are made from gold as well. Other award statues and prizes are depicted in gold or are gold plated (such as the Academy Awards, the Golden Globe Awards, the Palme d'Or, and the British Academy Film Awards).

Aristotle in his ethics used gold symbolism when referring to what is now known as the golden mean. Similarly, gold is associated with perfect or divine principles, such as in the case of the golden ratio and the golden rule.

Applications of Gold metal image processing

Gold is the most malleable of all metals; a single gram can be beaten into a sheet of 1 square meter, and an avoirdupois ounce into 300 square feet. Gold leaf can be beaten thin enough to become semi-transparent. The transmitted light appears greenish blue, because gold strongly reflects yellow and red. Such semi-transparent sheets also strongly reflect infrared light, making them useful as infrared (radiant heat) shields in visors of heat-resistant suits, and in sun-visors for spacesuits. Gold is a good conductor of heat and electricity.

In the field of Electronics

Only 10% of the world consumption of new gold produced goes to industry, but by far the most important industrial use for new gold is in fabrication of corrosion-free electrical connectors in computers and other electrical devices. For example, according to the World Gold Council, a typical cell phone may contain 50 mg of gold, worth about 50 cents. But since nearly one billion cell phones are produced each year

In Medicine field

Metallic and gold compounds have long been used for medicinal purposes. Gold, usually as the metal, is perhaps the most anciently administered medicine and known to Dioscorides. In medieval times, gold was often seen as beneficial for the health, in the belief that something so rare and beautiful could not be anything but healthy. Even some modern esotericisms and forms of alternative medicine assign metallic gold a healing power. ^[4]

EXISTING METHOD TO FIND THE QUALITY OF GOLD

Currently there are three methods available to determine the purity of gold. They are namely.

1. Touchstone Method
2. Using Electronic Devices
3. X-Ray Method

1. Touchstone Method

There are a few scientific methods for precisely determining karat gold purity, some destructive (fire assay) and others nondestructive (X-ray fluorescence). Both methods require costly equipment, special procedures and a well-lit and ventilated area. A simpler method for determining gold purity in jewelry is the “touchstone” testing process, an age-old technique that is relatively nondestructive to jewelry and offers quick results.

Touchstone testing incorporates the use of acids, so pay close attention to safety. Careful procedures are a must. Touchstone testing is based on the fact that 24k gold resists all but the strongest acids. The purer the gold, the stronger the acid required to dissolve it. Measured strengths of nitric acid are used to test for 14k and lower. Aqua regia, a mixture of one part of nitric acid and three parts hydrochloric acid, is used to test higher karat purity through the process of comparison and elimination.

To conduct touchstone testing, an acid testing kit is used (available through jewelry tool suppliers), a well-ventilated area, two glass beakers, water, baking soda, protective gloves, 320-grit abrasive paper, safety goggles, and paper towels.



Figure1: Test kit for Jewellery

The testing kit includes a set of testing needles. Each needle has a karat gold sample on its tip and the karat value stamped on the side. Use yellow gold needles for testing yellow gold, and white gold needles for testing white gold.

Each known test sample is labeled on the needle. Rub the known samples onto the stone and label each on the testing stone.

Begin by checking the gold jewelry piece for other stampings (e.g., quality marks or manufacturer’s marks) and make note of characteristics such as heft, color and reflectivity. If you suspect the item may not be gold, use an engraving tool and make a small notch in an unobtrusive place on the jewelry to expose fresh metal. Next, put on protective gloves and place a drop of acid from the 18k gold testing bottle over the small notch. A highly effervescent green

reaction indicates base metal, and no further testing is required.

If there is little or no reaction, the piece is likely karat gold, and the next test is for purity.

Follow these steps:

- Rub the jewelry of unknown karat purity gently back and forth on the testing stone to leave a thin, but clearly visible, metal sample. Care to be taken for the sample from a place not clearly visible.
- With a testing needle, draw a question mark on the touchstone that represents the unknown metal.
- Start with the 14k testing needle and rub a layer next to the unknown. Label it “14.”
- Repeat this process, making a layer and then labeling with the 18k, 22k, and 10k testing needles. Now choose the bottle labeled for testing 10k and lightly swipe the applicator across all the samples.
- After approximately 20 to 40 seconds, place the touchstone in a mixture of baking soda and water to neutralize the acid in one beaker, then rinse in water in the other beaker.
- Blot the touchstone with paper towels and observe. The 10k sample has dissolved, but the unknown metal is still visible. This confirms the unknown metal is finer than 10k.



Figure2: Testing needle

- Next, choose the bottle labeled for testing 14k and swipe it across the samples just below the first test.
- Allow enough time for the acid to react and neutralize, then rinse and blot the touchstone and observe. The acid has dissolved both the 10k and 14k samples. The unknown metal is therefore 14-karat or slightly higher.

Analyze the test results to determine the karatage.

Always prepare the touchstone for its next use by cleaning it thoroughly. Remove the metal from the stone's surface by placing it face down on a piece of 320-grit abrasive paper on a flat surface. Apply moderate pressure and sand it in a circular motion until sample layers are no longer visible. Neutralize, rinse and blot dry before replacing in the kit. Always follow the manufacturer's directions for the proper care, storage and handling of acids. ^[5]

2. Electronic Method

Some jewellers may also use electronic gold testers to figure out the quality of a piece of gold. The device tests the gold's electrical conductivity — this property not only tells the jeweller if

the material is actually gold, but also its purity. Electronic gold testers are fairly accurate when used properly



Figure3: Electronic Gold



The gold is placed on the interface to the PC/Any other Gadget. Then with the probe the gold piece is rubbed and the Purity of the gold is displayed with the help of the Gadget.^[6]

3. The X-Ray Fluorescence (XRF) Method

When exposed to high-energy radiation, atoms usually emit X-rays which correlate with the source element's atomic number. Upon analysis of the emitted X-rays, one can determine the presence of gold and alloys. Devices analyzing metal content, like this one (pictured below) by Thermo Scientific, can perform this analysis with the mere press of a button.^[7]



Figure4: DXL Metal Analyzer

The Nikon DXL Precious Metal Analyzer by Thermo Science

While fast and convenient to use on some pieces, the XRF method may not be appropriate for any test subject. X-rays cannot travel beyond the surface of metal, meaning that only a small area can be tested. Developing technologies, however, can help determine the probability that a piece is gold-plated. Finally, pieces with a unique surface, such as relief work, may prove difficult to accurately test.

OBJECTIVES

- To implement the algorithms for determining the Purity of Gold using digital image processing and implement it using mobile apps.
- To do a case study on the quality of gold metal, a method for determining the purity of Gold.

- To build a system to determine the purity of gold using image processing.
- To develop a new approach to automate the process used in the industry.
- The methodology also Differentiates between Gold plated metals and the Original Gold.

SUGGESTED MODEL

1. Input a 2D or 3D Image of gold ornaments

An Image sample is of the form given below is taken from the Mobile phone camera and then it is processed using the threshold Image Segmentation Algorithm.

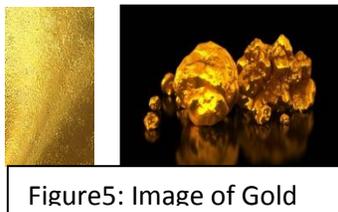


Figure5: Image of Gold

2. POPSCAN Threshold Segmentation Algorithm is used for image processing; to make it compatible with mobile phones java is chosen.

At every step of the algorithm the pixels of the image is scanned and reassigned this makes it more efficient for the image to be scanned and taken into the mobile phone system properly.

3. The sample image of Gold is Scanned 3 times and the comparison is made for the mean value.

The Algorithm captures 3 different images and takes the best fit image out all the 3 sample images, there by eradicating any space for missed out crevasses or depressions in the Gold surface.

4. The user is also prompted to use touchstone method if step 3 is flaged invalid.

If the algorithm is flagging the image is invalid then the traditional touch stone method is used to find out the karatage of gold using some over the shelf substances thereby making this as a lost resort if the algorithm should fail. Then the picture of the gold sample after doing the touchstone method is taken to the 5th step

5. The Image obtained in Step 4 will undergo comparison with the original gold metal value and with sample gold image

The image is taken and compared with the original value of touchstone image available in the database and the purity is taken into consideration.

- The extracted value will be the result. The final value is used for judging the quality of gold.

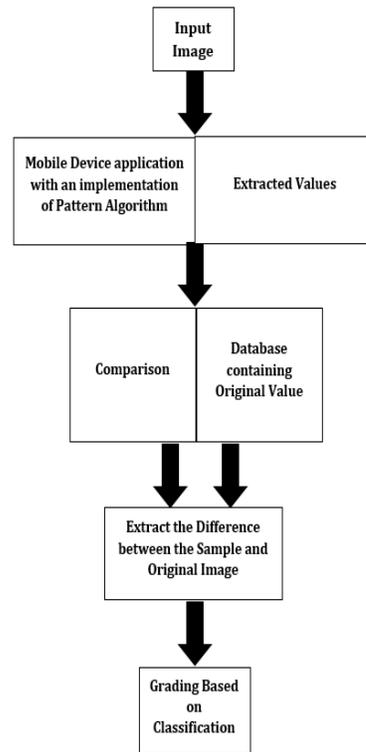


Figure 6: Working of the Proposed Model

Step 1: 3 Trial Images of the given piece of gold is captured from the Mobile device.

Step 2: POPSCAN based on threshold algorithm is used to extract the colour form of the captured image.

Step 3: The algorithm is coded using the suitable mobile apps. And the extracted values are used for the Analysis.

Step 4: The captured image is compared with the database which contains the original value.

Step 5: The Difference between the Sample and the original value is found.

Step 6: The Gold is graded based on the Difference and the Result shown.

The image processing algorithm used in step 2 is explained below. *

In the above algorithm,

- The image is broken down into pixel segments.
- If the image is blurred out or of low quality, the algorithm tries to recover it.

- It is then created it into a new pixel segment called as seed and added to the captured image. To make it full.
- The first point is then extracted and kept in a temporary variable called as candidate and then compared.
- If the candidate has the colour within in the threshold limit then the candidate is put into the image segment.
- Likewise, the candidate pixel is compared and arranged accordingly with accordance to its position in the original image.

LIMITATIONS

- People who are technologically well versed will only be able to use the proposed system.
- Different shades of light or the surrounding environment may pose a problem for the accuracy.
- Quality of the image should be good enough for processing and identifying the object purity.

CONCLUSION

The digital media that helps to analyse the image of an ornaments is becoming more common due to its effectiveness and efficiency. The proposed model can be helpful for the merchants and customers those who purchase and sell Gold. The analysis helps both persons to know the purity and further to judge the cost of it. This model can also be enhanced for other metals such as copper and silver.

REFERENCES

1. https://link.springer.com/chapter/10.1007/978-1-4020-4385-7_10
2. <https://link.springer.com/protocol/10.1385/1-59259-064-0:37>
3. <https://link.springer.com/protocol/10.1385/1-59259-064-0%3A37?no-access=true>
4. <https://www.skilled.io/u/flexmonkey/introducing-image-processing-in-metal>
5. <https://www.ganoksin.com/article/touchstone-method-testing-karat-gold-purity/>
6. <https://www.bruker.com/products/x-ray-diffraction-and-elemental-analysis/handheld-xrf/applications/mining/xrf-gold-testing.html>
7. <https://www.livescience.com/29188-how-to-check-gold.html>