IoT based detection of adulteration in Gold using ANN

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ABSTRACT. According to the old sayings, “All the glitters are not gold”. We should be very aware of this quote. Nowadays we don’t get a pure crystalline of gold (Au). The Gold (Au) cannot itself be made into proper jewellery, so it needs some impurities as such to make and sell them into a product. So, in olden days to till now the gold (Au) is mixed with Copper (Cu) to make it into a nice wearing’s and products. The Copper (Cu) is not only mixed with Gold (Au) it is also mixed with silver, Palladium, Platinum and more. Nowadays the iridium is mixed with gold to enhance the weight of the gold. Thus the gold sellers sell the iridium (Ir) mixed gold (Au) to the traders. Unknowingly the traders get the gold (Au) as of such in a high cost. The iridium (Ir) cannot be identified. It can be identified only when the gold (Au) is melted. The nature and property of gold remains the same when mixed with iridium, but the mass of the gold (Au) gets inflated. Thus the proposed system uses the x-ray to identify the Proportion of iridium (Ir) in gold (Au). The Controller senses the image captured by the x-ray machines and matches them with the other samples taken from the pure Gold (Au) through Back Propagation algorithm and finds the error. The identification of such these will not cost more. It is highly efficient and traces the impurity in gold and provides the traders with at most satisfaction.

Keywords: X-ray, Processing units, Internet of things, artificial neural networks, Iridium (Ir), Gold (Au).

1. INTRODUCTION

The Gold (Au) is the most valuable ornament and most alluring possession of the people. Many of us like to wear Gold ornaments and love to have them. It shows the prestige, courage, love and more. Meanwhile, people like to have them because of its attraction.

The proposed system is a frame work for many other applications of finding adulteration in metals, not only in gold (Au) but also in the other metals. The figure: 1 represents the Colours of Au-Ag-Cu alloys as a function of composition.

Basically the gold (Au) is so soft to handle with so, it is been allowed to combine with the other metals to make it hard to process them into bars or coins or sheets.
\[ 3Cu + 2AuCl_3 \rightarrow 3CuCl_2 + 2Au \]  

(Copper + Gold Chloride \rightarrow Copper chloride + Gold precipitate)

Maximum of the reactions comes with copper (Cu) as like the copper is cheap than the silver (Ag) and gives more brittleness. So, the malleability property is also been enhanced by the same. Thus the most of the alloying of gold is used with the copper (Cu). We will get the range of 22 karat gold (Au) as pure; because the 2 karats is added with impurities to make them malleable and ductile, i.e., we have 91.66% of gold (Au) and the rest is the impurities.

\[ IrCl_3 + 2AuO_3 \rightarrow AuIr + 3ClO_2 \]  

(Iridium chloride + Gold Oxide \rightarrow Gold Iridium + Chloride)

Mikkelsen, S. L., & et.al., (1988), in his proposed work found the adulteration by the aqua regia process. The aqua regia is a mixture of HCl and HNO_3. In which the Hydro chloric acid erodes some of the gold Particles. This causes the loss of the pure metal [2,11-17]. Cody, (1989) in his proposed work identified the adulteration in drugs by the transmission electron microscope. But the TEM is so costly to afford and it needs an expert to deal with [8]. Novakowski, W., & et.al., (2011) in his work proposed the manufacturing of the gold with copper electrodes for the sensitive element identification. Thus in their work the property of the gold is mainly discusses such that how they gets reacted to other metals and form its own property. [5]

Ali, M. E & et.al., (2012) in his work found the visual detection of adulteration of the gold is identified by the scanning electron microscope. He could identify the internal structure of the metal.

Figure: 1 Colours of Au-Ag-Cu alloys as a function of composition.
But cannot identify how many percentage of the impurities were and what kind of the impurities id been added to the Gold (Au) [1]. Mecker, L. C & et.al., (2012) in their work found the adulteration in gold by the Raman spectroscopy techniques. They used the light scattering technique, but it is not much efficient and the method is too costly to implement [3, 18-21]. Zheng, D & et.al., (2012) in their work the internal atomic structure and the molecular arrangements were been discussed briefly, such that the metallurgical ways are been identified by the molecular bindings and thus they could expose the adulterers in the metals [6].

Kumar, N., & et.al., (2014) in his paper, the attainment of the milk adulteration is identified by the gold nano particles. In his proposed work the adulteration is been identified by the calorimeter. By the same we use the X-ray spectroscopy for identifying the Adulteration in an efficient way [4, 25]. Kumar, P & et.al., (2015) in their paper, the urea adulteration in gold Nano particles is been identified by the bios sensors called the apt sensors. Thus the sensors are used to find the most remarkable adulterations in the metallurgical surfaces [7, 22]. Guo, (2015) in his proposed work, the Raman’s high speed spectrograph methodology is used. Thus the efficiency is negligible [9]. Bransford & et.al.,(2000). The appreciation of the high-tech resources is discussed and the maintenance of their approval is been activated through the artificial neural networking techniques [26]. Raichle, M. E., & et.al., (2001) thus the back propagation methodology is used to consolidate the work being done and produce the output to a greater extent of efficiency [27-30].

Gubbi, J., Buyya & et. al., (2013), the Internet of things is mainly used for the data storage in the random view of the pulsating clouds. The clouds are the highly secured modes of data collecting arenas that make use of the storage of the data’s. Thy deserving part of the Internet of things is that makes use of the data acquisition in the clouds [32]. Kelly, S. D. T., & et.al., (2015) in his paper iteratively manages to store the bulk data for the higher classification of ranges . The data’s are taken into account and make sure to get damaged but the security system is reliable. [33-40]

2. METHODOLOGY:

Gold is the most precious metal of all times, to which the sellers adds the impurities of all kind. The impurities cannot be detected in the normal eyes. It can only be detected when melted or treated with aqua regia. Thus the proposed system uses the x-ray modelling to enhance the output of the crystallographic view. The input image is taken in the form of predefined x-ray images through the Back propagation algorithm. The algorithm used here may be so simple but it enhances the feature of the use.

![Cloud]

**Figure: 2** block diagram of the proposed system.

The featured system blocks are the simple layout of the proposed system. The input image is fed from the X-ray scanned images which were already been taken into account by the Artificial neural networks. Thus when the ornament to be tested is placed under the system, it starts scanning by the x-rays provided with them and analyses them through the Predefined stored images in the cloud nad makes appositive result of the output containing the impurities. The sustainable impurities were been
identified by the RPROP algorithm. The controller unit used here is an Arm processor which processes the data by the usual C language.

The RPROP algorithm uses the adaptive learning techniques. Most probably the step size tries to overcome the choice of the connections during the learning processes. This technique provides the accuracy, reliability and the robustness to the output. The weight of the network is been calculated and fast forwarded to the next layers and amended as the output. The weight of the network is been denoted as $W_{ij}$ where the weight denoted from the neuron i to the neuron j.

Figure: 3 the input of the proposed system for training the Neural Network.

The input images are taken into account for training the Neural Network through the RPROP algorithm. The algorithm is based on the following rule:
\[
\Delta_{ij}^{(t)} := \begin{cases} 
\eta^{+} \cdot \Delta_{ij}^{(t-1)}, & \text{if } \frac{\partial E^{(t)}}{\partial w_{ij}} \cdot \frac{\partial E^{(t-1)}}{\partial w_{ij}} > 0 \\
\eta^{-} \cdot \Delta_{ij}^{(t-1)}, & \text{if } \frac{\partial E^{(t)}}{\partial w_{ij}} \cdot \frac{\partial E^{(t-1)}}{\partial w_{ij}} < 0 \\
\Delta_{ij}^{(t-1)}, & \text{else} 
\end{cases}
\]

(1)

where \(ij\) are the two networks of the systems

if \(\frac{\partial E^{(t-1)}}{\partial w_{ij}} \cdot \frac{\partial E^{(t)}}{\partial w_{ij}} \geq 0\) then

\[
\Delta w_{ij}^{(t)} := -\text{sign} \left( \frac{\partial E^{(t)}}{\partial w_{ij}} \right) \cdot \Delta_{ij}^{(t)},
\]

(2)

where \(w\) is the weight of the network and \(E\) is the Activation factor of the input and the hidden layers.

if \(\frac{\partial E^{(t-1)}}{\partial w_{ij}} \cdot \frac{\partial E^{(t)}}{\partial w_{ij}} < 0\) then

\[
\Delta w_{ij}^{(t)} := -\Delta w_{ij}^{(t-1)} \text{ and } \frac{\partial E^{(t)}}{\partial w_{ij}} := 0.
\]

(3)

tends to operate in a passive mode and again we need

\[
w_{ij}^{(t+1)} := w_{ij}^{(t)} + \Delta w_{ij}^{(t)}.
\]

(4)

if \(\frac{\partial E^{(t-1)}}{\partial w_{ij}} \cdot \frac{\partial E^{(t)}}{\partial w_{ij}} < 0\) and \(E^{(t)} > E^{(t-1)}\)

then \(\Delta w_{ij}^{(t)} := -\Delta w_{ij}^{(t-1)}\).

(5)

due to the defined equation profoundly illuminates the Equivalency through the Network layers.

The output equation of the system is defined to be

\[
E_a(w) = \sum_{i=1}^{n} \left( a^{i-1} \langle w, o_i \rangle \right)^2.
\]
The input layers of the network provide a meshy looping area and that trains the system by the RPROP algorithm. The algorithm trains the system to get a higher efficient and gradient system of all. The proposed system model is given below.

The output is been updated to the cloud for further updating of the inputs through the Artificial neural networks. Thus Internet of things is been playing a vital role for collecting the data base for the inputs. Thus the Iot is been Accesses by the Open foam, an Open source platform for accessing the data’s.
3. RESULT AND DISCUSSION:

The Proposed system model identifies the Iridium mixing in the Gold. The iridium cannot be separated easily until it gets melted or then it gets into the aqua regia. The iridium, the rarest metal in the earth but costs very less than the other impurities is been used prominently used in the adulteration of gold. Thus the output of the system provides a good result for proving the adulteration of iridium. Thus the iridium causes cancer and prolong usage of the adulterer material causes the person with many diseases. Thus the output of the system is defined below:

[Figure: 6 Output of the proposed system.]

4. CONCLUSION:

In an attempt to enhance the output stability and its performance the RPROP algorithm is used. Thus the Artificial Neural network is the main factor of unrevealing the issues in the metal. The system adheres to the greater extent of the arena that everything is been adultered. Most probably the Internet of things is used for the Data storage and back upping the outputs. The total backing up makes the system to work more consistently with higher range of efficiency with efficacy.

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