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An automated system to detect feature variations of planet Jupiter

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The giant planet Jupiter is the telescope-user's delight with interesting cloud belts, cyclones, anti-cyclones and other fascinating features. This paper describes an inexpensive and accurate automatic technique developed using image processing methods to detect the variation of features on the planet Jupiter. The study was focused on the two main features namely the Great Red Spot (GRS) and shadows cast by Jupiter moons on the planetary disk. GRS is a very fast storm in Jupiter's atmosphere rotating anti-clockwise and completing a full rotation in six days. Observing the GRS is one of special treats in astronomy. A method of detecting the GRS was developed using both image processing and clustering techniques. With the help of this developed system, one can detect the GRS well and measure the size of its long axis within an error range of 0.1%. Using this new technique 35 Jupiter images captured during the period 2010 – 2014 were analysed. In 2004 the size of the GRS was found to be 16570 km across. It is found that the GRS has begun to shrink and from 2010 to 2014 the red spot had shrunk at a rate of 375 km per year and its shape is gradually changing from an oval to a circle. These values are in agreement within an accuracy of 97% with those of other researchers obtained through manual methods.

Another method was developed to automatically identify Jupiter's Galilean moons by using the shadows of moons on the planet. This is important because sometimes even an experienced astronomer may not be able to identify the exact moon which transits by looking at the shadow. With the help of this developed automatic method, anyone can identify which moon belongs the respective shadow cast on the Jupiter disk. Both image processing and Artificial Neural Network methods were used to develop this method. The Artificial Neural Network was trained using supervised learning to classify the largest four moons of the planet Jupiter, Europa, Io, Ganymede and Callisto. The trained network was capable of identifying the moons at a success rate of 95.5%.

This technique can be further extended to detect other features of Jupiter as well with the combination of both image processing and Artificial Neural Networks.

Keywords: Great Red Spot, image processing of Jupiter features, Jupiter moons.

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