

## Satellite based identification of archaeological monuments sites of Gwalior, MP, India

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### Abstract

Gwalior cultural legacy consists of rich archaeological ruins (monuments) and we made efforts to identify the important sites using remote sensing techniques. The satellite images provide data for mapping of the cultural heritage site areas on high resolution. The improper mapping has caused a serious cultural crisis where such monuments are depicted with ordinary symbols and only few well known monuments are mapped.

**Keywords:** Visual elements, image interpretation key, satellite data, Gwalior.

### Introduction

The importance of satellite image technology to identify archaeological ruins has been paid great attention worldwide mainly because of high resolution satellite data such as IKONOS, Quickbird, Cartosat data are able to match with aerial photogrammetric images and correlated with other data (Lasaponara & Nicola, 2006). Satellite remote sensing offers many useful and sometimes essential data for mapping, monitoring and management of world cultural heritage sites either natural sites such as parks or cultural sites such as archeological sites and monuments (Van Hooff, 1994; Hadjimitsis *et al.*, 2005). Similar attempts have been made by Sokhi (1989). The high resolution images are good for feature extraction and low resolution images are used for site selection and structural anomalies.

### Study area

The study area covers a part of Gwalior district which lies between longitudes 78°0' to 78°15' E and latitudes 26°0' to 26°15' N (Fig. 1). The area is marked on digital image of IRS 1-D LISS III multispectral image on 23.5 m. Resolution and Geocoded with SOI toposheet no 54J/4 on 1:50,000 scale and used other collateral data. Geologically, the area is covered with the alluvium, sandstone, dolerite, quartzite, shale, granite etc.

### Methodology

Visual interpretations of satellite image as well as digital data of study area have been considered to identify the anomalies in regular pattern because the presence of geometric features generally provides useful information

for the identification of sites indicating ancient human activities. The broad objectives are: development of interpretation key; interpretation of satellite image; mapping of monuments and sites; comparison of images with high resolution data and the interpretation methods are given in flowchart 1.

### Results

#### Interpretation of satellite data

The elongated structure of the Gwalior fort showing uniformly light tone and delineated as coarse texture with conspicuous regular shape (Fig. 2). The shape of the fort represents the structural anomaly. The size of the fort is 5.5 cm in length and 3.2 cm in breadth on 1:50,000 scale. Gently curved and elongated pattern are frequently of structural significance. Pseudo elevation pattern indicates the presence of relief in the area, since it has a peculiar shape and also delineate it from surrounding features (Fig. 3).

Flowchart 1. Procedure adopted for the identification of archaeological & historical monuments.

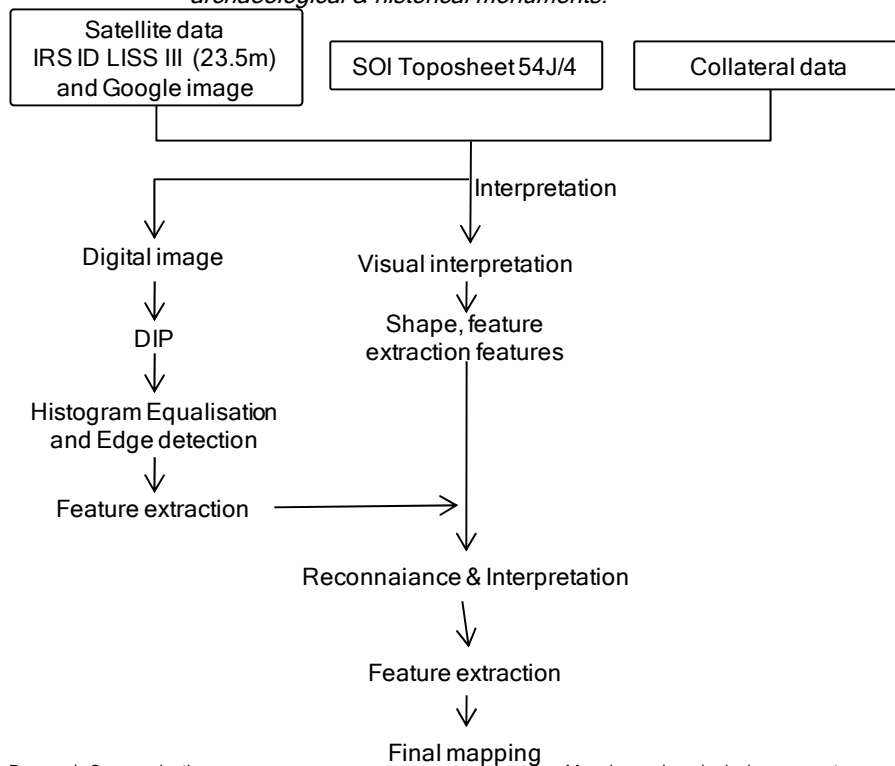
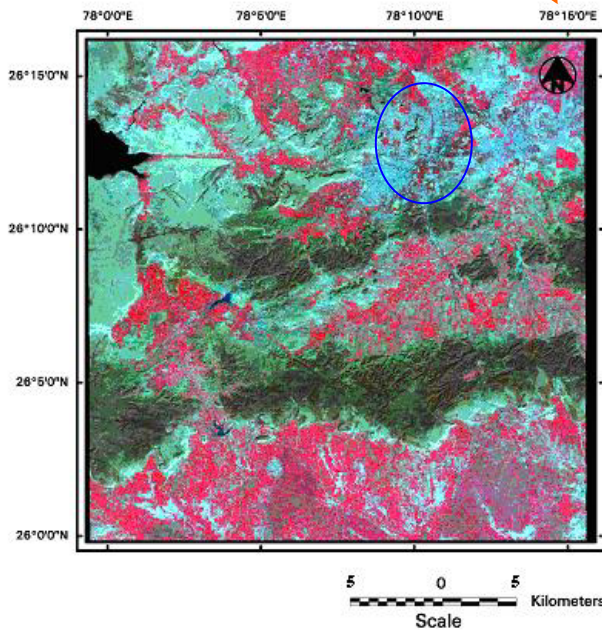
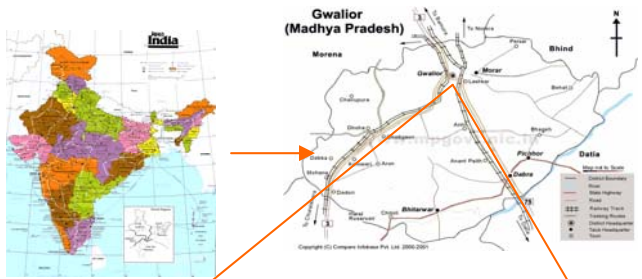
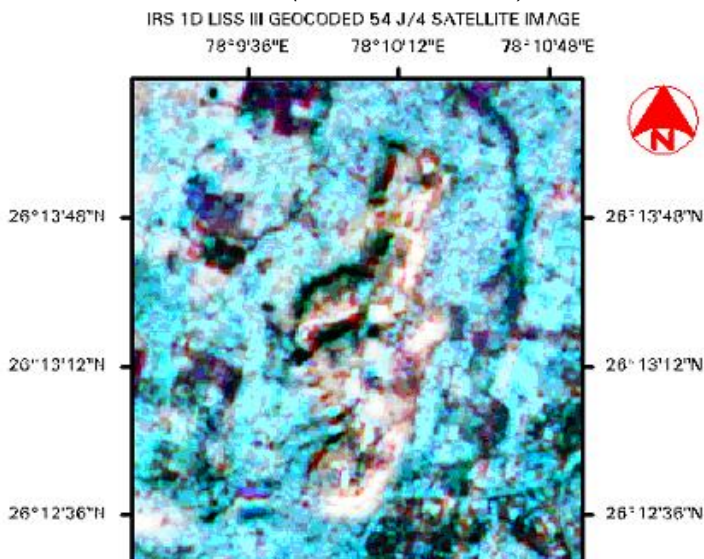


Fig. 1. Location map of the study area.



IRS 1D LISS III Geocoded 54J/4 satellite image.

Fig. 2. Elongated regular shape exhibited by Gwalior fort (Historical monument).



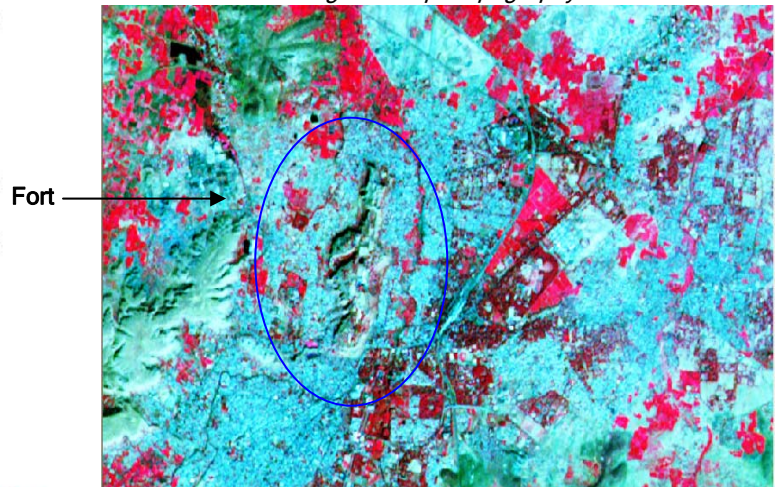
Digital image processing

The satellite based analysis using edge detection, histogram equalization; line extraction has been used for identification of the target fort. Image fusion refers to the process of combining multiple images with false colour composite of a scene of higher resolution to obtain a single composite image. Histogram equalization and edge enhancement techniques are used in the study area for emphasizing lineaments and the presence of buried structures.

Conclusion

Our work highlights the beneficial use of satellite remote sensing for the identification and detection of anomalies of monuments marks. Wider archaeological perspective is offered by remote sensing techniques in place of traditional ones for the archeological surveys. The interpretation keys viz. tone, shape, pattern variation and size which played a significant role in identification of monuments and sites. Finally, remote sensing helps to narrow down the desired area and inaccessible areas easily viewed and interpreted for monumental record.

Fig. 3. Historical monuments (Fort) are seen as negative & regular shape topography.



(IRS 1D LISS III 54J/4 Geocoded satellite image, Gwalior).

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