Geo-Spatial Data Generation and Terrestrial Scanning for 3D Reconstruction

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ABSTRACT: **Digital reconstruction of heritage sites is in vogue in most of the developed countries especially in Europe which offers several such heritage sites to promote historical research, virtual tourism, restoration, reconstruction etc. Keeping this in view a Programme on Indian Digital Heritage (IDH) has been evolved by the Department of Science and Technology to capture the rich heritage of India on a digital platform using modern advanced technologies for reconstruction and recreating through ages and also to use the information for holistic analysis.**

The project 'Digital Geospatial data generation and Terrestrial Scanning for 3D Reconstruction of Heritage site at Hampi under the 'Programme of IDH on Hampi' aims to develop digital geo spatial database including digital terrain of the entire site, 3D Geodetic framework of the important heritage monuments through high resolution terrestrial scanning and Global Position system(GPS) location of heritage monuments. In this paper the project team presents the results of the Digital Elevation Model created using the data collected

Keywords: **Indian Digital Heritage, Digital Elevation model, Terrestrial Laser scanning, Global Positioning System**

I. INTRODUCTION

In order to understand the nature of development and nature of spread of the township at different durations in its history, there is a need to capture the Spatial and Terrain information through Global Positioning Systems (GPS), Geographical Information System (GIS) and develop Digital Terrain Modelling(DEM) along with the information of the historical monuments on a Geo-Spatial Framework. This information is crucial for further analysis with regard to the temporal sequence of development, nature of spread of township, track the engineering skill developed through ages etc. Further such information is extremely useful in computer rendering and reconstruction purposes. Hampi situate on the banks of the river Tungabadra, the medieval capital of the Hindu empire Vijayanagara (the city of Victory) is one of the sites selected under the IDH programme by Department of Science & Technology, Government of India. Hampi is Charismatic even in its ruined state and is listed as one of the UNESCO World Heritage Sites. It is an open museum, having numerous heritage sites offering information for researchers and tourists who visit the site regularly, throughout the year.

This initiative is aimed at rendering support to the various Research groups and Administrators with information to learn, analyse and reconstruct the history through different periods of time, as well as trace the developments that had taken place with regard to culture, engineering, technology, trade etc. by enabling the researchers to interact with the monuments from their own labs and also assist the agencies in improving the tourism and reconstruction / restoration activities.

II. STUDY AREA

Hampi (Fig.1) is situated on the banks of the river Tungabhadra is 353 km from Bangalore and 74 km away from Bellary District in the state of Karnataka. Hospet 13km away, is the nearest railway station. Geographically it lies between 76^0 25' 47" to 76^0 29' 40" longitude and 15^0 17' 24" to 15^0 20' 24" latitude. The name "Hampi" is an anglicized version of the Kannada *Hampe* (derived from *Pampa*) which is the old name of the Tungabhdra River on whose banks the city is built. Hampi, was the medieval capital of the Hindu empire Vijayanagara (*the city of Victory*) from 1336 to 1565, till it was laid siege, plundered and destroyed by the Deccan Muslim confederacy. The Vijayanagara kings chose Hampi because of its strategic location, bounded by the torrential Tungabhadra River on one side and surrounded by defensible hills on the other three sides. Hampi is associates with mythology and identified with the mythological Kishkinda, the Vanara (monkey) kingdom mentioned in the Ramayana. It is important due to its history and architectural marvel. Hampi is charismatic

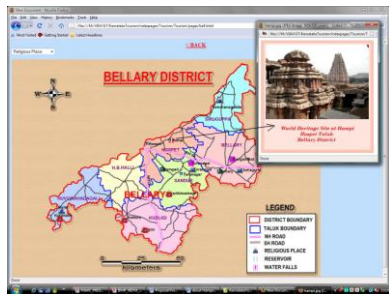even in tis ruined state and is listed as one of the UNESCO World Heritage Sites.

Fig. 1 Location Map of Hampi heritage site in Bellary District, Karnataka state

III. METHODOLOGY

The methodology adopted for the work include control surveying and re-establishment of control points on the existing high resolution topographic maps prepared by Survey of India (SOI) for some area, Laser Scanning of monuments using terrestrial laser scanner and finally, a three dimensional geographical database will be developed in GIS environment for Geo-Visualization to create and reconstruct virtual tourism.

The detailed approach is described in the following sections.

- Collection, collation and digitization of existing topographical-maps, thematic layers like hydrology, soil, geology etc., and other infrastructure and socio economic parameters using GIS software.
- Surveying and re-establishment of control points on the existing topographic maps of the SOI using GPS and other survey methods.
- Creation of Spatial Database- Digital Elevation Model (DEM) of the terrain using Contours and Spot heights (Fig 2 and Fig 3) , 3D modelling of monuments

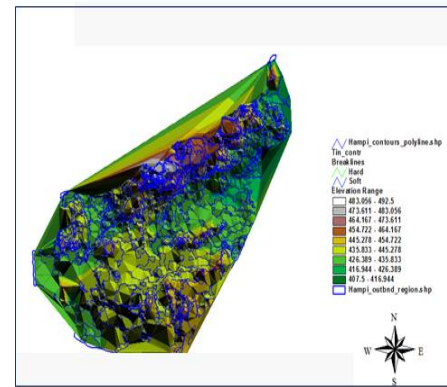for Geo visualization and virtual reconstruction of monuments.

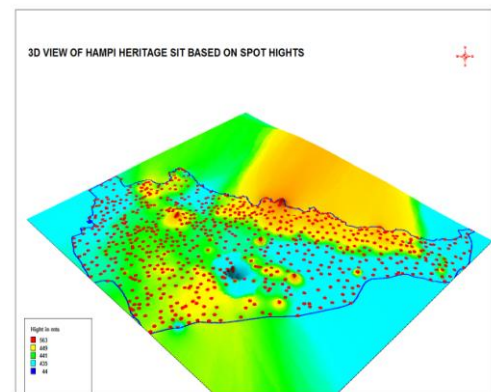Fig. 2 Digital Elevation Model (DEM)generated based on Contours

Fig..3 3D view of Hampi heritage site based on Spot Heights

IV. RESULTS

Terrestrial laser scanning provides highly accurate, three dimensional images enabling designers to expertise and work directly with real –world conditions by viewing and manipulating rich point clouds in computer aided design software. By sweeping a laser beam over a scene or object, the laser scanner is able to record millions of 3D points. These X, Y, Z measurements can then be imported into CAD or 3D application software and displayed as a "Point Cloud". A point cloud is a set of vertices in a three dimensional coordinate system. These vertices are usually defined by X, Y, and Z coordinates.

These point cloud can then be converted into 3D mesh models. Since all laser scan points are 3D, the files can be viewed, navigated, measured and analysed as 3D mesh models. A polygon mesh model is a collection of vertices,

edges and faces that defines the shape of a polyhedral object in 3D computer graphics and solid modelling. Engineering drawings are generated for monuments in 2Dimensional CAD format (fig. 6) using mesh data. Drawings of plans, cross sections and elevations of monuments were generated. These Engineering drawings could be used for recreation or reconstructing the monuments. Colour panoramic views, video files and Virtual walkthrough can be generated on 3D models of the monuments which is useful for Ge0-Visualization and Virtual reconstruction of monuments. The below Fig.4, 5 are the outputs from Terrestrial Laser Scanner.
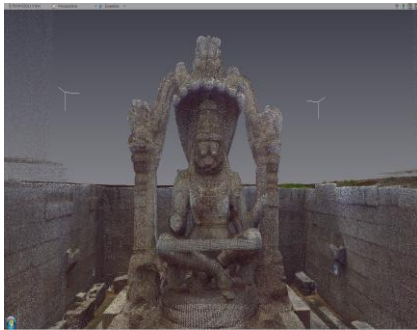
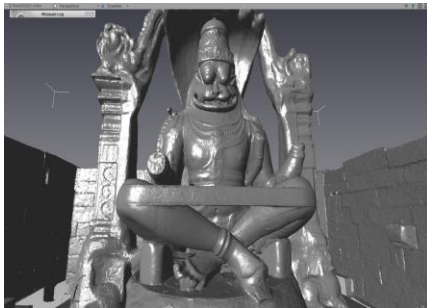Fig.. 4 Point cloud data of Lakshmi Narasimha Statue
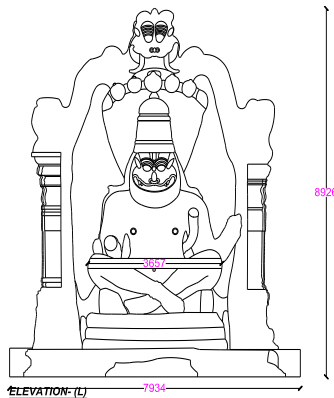

Fig.. 5 Mesh Dats of Lakshmi Narasimha Statue

Fig. 6 Engineering CAD drawing of Lakshmi Narasimha Statue

V. CONCLUSION

The output would become global visualization of historical monuments of Hampi which helps in virtual tourism of world heritage site at Hampi. Helps in up gradation of infrastructure facilities and socioeconomic conditions of the local population. Digital documentation of Hampi heritage site facilitates the Government and UNESCO for preservation, protection, restoration and reconstruction of monuments. Enables the researchers and Historians to learn and carryout research to reconstruct the history of existing, ruined and hidden underground monuments.

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BIOGRAPHY

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