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EXPLORATION OF GEOLOGICAL AREAS USING DRONE SIMULATION

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Abstract: **Flight Planning and Modeling is a modelling methodology that can be used for the purpose of exploration of geological areas. It helps to understand the details of sedimentation rocks, foreland basins, changes in sea – level, aquifer, elevated areas, country rock, crest etc. In this system we have concentrated on stratigraphic creation of landscape of elevated areas. The flight planning and modeling view that gets generated through various resources is not very precise with respect to the 3D modelling. The View lags certain area depth, elevation and resolution. The Stratigraphic view of landscape that our system generates uses Finite Element Modelling. Finite element modelling serves as an aid for the creation of high-resolution landscape view of elevated areas. The system generates a model that describes the geological aspects of areas which are of major use to geologist. The 3d model that the system generates provide the ability to create renderings for design proposals. The concepts of Flight Planning and Modeling Photogrammetry, Orth mosaic and solid meshing has been used to generate the geological 3d model. The photogrammetry model and MATLAB model is given as an input to finite element modelling to generate the 3d model.**

Keywords: **Drone, Matlab, 3D Model, Augmented Reality.**

I. INTRODUCTION

The system generates the 3d Model of a given landscape. The main focus of the system is to convert a 2d image into 3d model with absolute precision. It optimizes the accuracy of visualization of stratigraphic landscape. The system converts the 2d satellite view into accessible 3d model. The system focuses on generation of geological model based on the amalgamation of latitude, longitude and elevation of data sets. The system generates the 3d Model of a given landscape. The main focus of the system is to convert a 2d image into 3d model with absolute precision[1]. It optimizes the accuracy of visualization of stratigraphic landscape. The system converts the 2d satellite view into accessible 3d model. The system focuses on generation of geological model based on the amalgamation of latitude, longitude and elevation of data sets. This model is further merged with the Photogrammetry model through Flight Planning and Modelling and the Augmented Reality 3-D model is generated.2-d model is less suited to concept design and is harder to explore alternative ideas because here the focus is on individual drafting entities, rather than facilitating the consideration of alternative design options. Whereas 3-d model removes design ambiguity and is highly appropriate for rending's and simulation.2-d model is less suited to concept design and is harder to explore alternative ideas because here the focus is on individual drafting entities, rather than facilitating the consideration of alternative design options. Whereas 3-d model removes design ambiguity and is highly appropriate for rending's and simulation. The benefit of being able to visualize a model better in 3d provides the ability to create photo realistic renderings that isn't easily possible within 2d design modelling due to inability of adding 3d imaging onto a flat view of product [2]. Editing the components separately is the main advantage of 3-d design modelling as it provides higher level of accuracy and the ability to see how components line up against each other which is not possible in 2d design model, as it comes to the potential issue of components not fitting or lining up due to only being able to see all the components in 2d perspective.2d modelling is usually difficult to use for prototyping. It is unreliable as well as unsuitable for rapid prototyping [3]. While on the other hand, 3d modelling provides an ease of prototyping and leveraging existing 3d models to evolve into new concept design is also straightforward.

II. REVIEW OF LITERATURE

Solid meshing of 3D geological model in finite element analysis: a case study of East Azerbaijan, NW Iran [1]
Proposed a system whose main aim is solid meshing of 3D geological body that includes topography for study of finite element analysis. Idealization of finite element analysis is done by following the procedure of shape function definitions from linear plane to solid elements. Both finite difference (FD) and FE methods are used to solve these model equations present in the system. The study includes the definition of solid meshes for 3D model considering topography which process topographic loads besides the dynamical analysis. This study deals with 3D building of geological block diagram and solid meshing with consideration of topographical loads. The shape functions in this research is majorly concerned with linear elements. The study area used for this research was western Alborz-Azerbaijan structural zone (Nabavi 1976) in north western Iran. Since this area has a history of destructive earthquakes and also includes many important elevations that are suitable to creating

3D geological block diagram. Therefore, an ideal solid meshed related to such geological block diagram can be responsive for loads about topographic variations.

Finite element model (FEM) visualization and post-processing tool for Open Sees [2]
Proposed a system to analyze and design structures that can survive the effects of earthquake. This system is of major use in the field of geological surveys of earthquakes as it provides a powerful solver with many standards and constitutive material models, finite element types, boundary conditions, and analysis capabilities. Reviews is developed to address the generated limitations by incorporating a GUI connection. For the purpose of research and development Review was used. The changes in the surface post-earthquake can be analyzed using the 3d models developed using this system.
The 3d models are designed on the basis of the surface before and after the earthquake. Both the before and after images are analyzed and compared and the 3d model output is then obtained. The precision is obtained by applying finite element modelling on the given images.

Finite Element Modelling in Structural and Petroleum Geology [3]
The work presented in this thesis lies on structural geology, geomechanics and various numerical methods. These 3d models are defined to represent an idealization of the geological reality and to allow the understanding of the assumed phenomenon. At first the method which has been used for simulating geological processes is the called analogue modelling.
This modelling includes the creation of 3d models using finite element modelling, based on similarity rules between the three fundamental physical units, by this model can be defined at reduced geometric and time scales. The basics about the finite element formulation used in this work, includes finite strain aspects. Special care is given to the formulation of structural and petroleum geology. By this model the simulation of models with high strain localization level is carried out with the help of the developed remeshings algorithm and finite element modelling which in turn gives them precise information.
Flight Planning and Modeling of oil and gas reservoir in sity stress based on a 3d corner-point grid model. Proposed a three-dimensional (3D) corner-point grid model that gives a relatively accurate description of the structural properties and spatial distribution of oil and gas reservoirs rather than using Cartesian grids. The stress distribution is done using finite element modelling.
Modelling is done using different statics algorithm are used For oil and gas reservoirs, which have complicated structures, great burial depths, and high heterogeneous attributes. It is not possible for FEM to develop a sufficiently accurate 3d model but with the help of grid generation sufficient precision can be obtained. But due to variation in different types of grids a geological model based on corner-point grids cannot be directly used for finite element simulation.
Due to these limitations in the modeling features of finite element simulation programs, it may not use these programs for establishment of a model. Thus, due to these major drawbacks, Geological modeling programs uses corner-point grids to provide a fine description and characterization of reservoirs.

III. 3. PROPOSED METHODOLOGY

In this, an augmented reality-based approach and suitable finite element modelling technique are proposed to develop the research solutions.
A system needs to developed that would create a definite model of the provided elevated and elongated area. Input would be a MATLAB model that needs to be merged with photogrammetry model and that would undergo finite element modelling generating the explicit 3-D model.

3.1 Collection of Data

The data collection refers to a plan for gathering data, information from field situation and is a process of measuring and analyzing accurate data from a variety of relevant sources.
The study area is selected from google earth, the entire area is covered by collecting the data points and tracing the path by connecting them.
At the end, the KML file is generated consisting of raw data including latitude and longitude. For generation of 3-D model the combination of latitude, longitude and altitude is required and therefore will be filtered out from the raw data.

Fig: 3.2.1 Collection of Data

3.2 Processing of Datasets

The KML file generated provides information about the Longitude and Latitude but the Altitude needs to be fetched further.
The KML file is converted to the GPX file by online GPS Visualizer to collect the altitude. The GPX file is further processed to fetch the details related to longitude, latitude and altitude.
The GPX file is processed through MS Excel, which consists of raw data in tabular format. The final required latitude, longitude and altitude is filtered out in tabular format from that MS Excel file.

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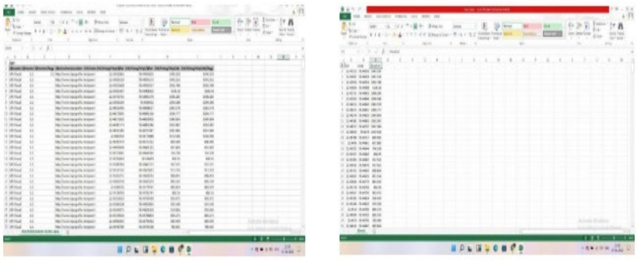

Fig: 3.2.2 Processing of Datasets

3.3 Generation of MATLAB Model

The Excel file consisting the details of latitude, longitude and altitude needs to be accessed further thrice in MATLAB to retrieve the latitude, longitude and altitude respectively. The information is interpolated in MATLAB and thus the input MATLAB model is generated.

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The FEM subdivides a large system into smaller, simpler parts that are called finite elements. This is achieved by a particular space discretization in the space dimensions, which is implemented by the construction of a mesh of the object

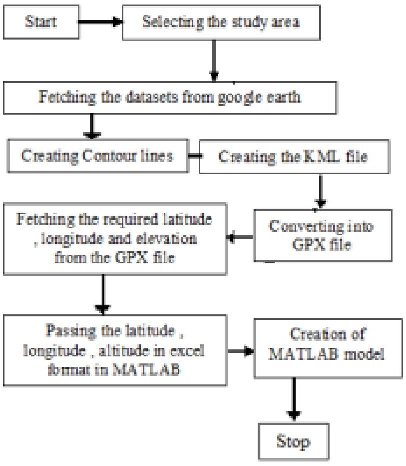

Fig :3.2.3 DFD for MATLAB module

3.4 Generation of Photogrammetry Model

The designing of Orth mosaic model through Photogrammetry is done by capturing the high-resolution real images of the areas. Minimum 100-200 images are imported into Creating Reality software.

The imported images are further made aligned in the system, all inputs are registered and enhanced through alignment. The resolution of the images is updated to High resolution. Creation of a complete 3-D reconstruction with texture or vertex colors using all inputs are done.

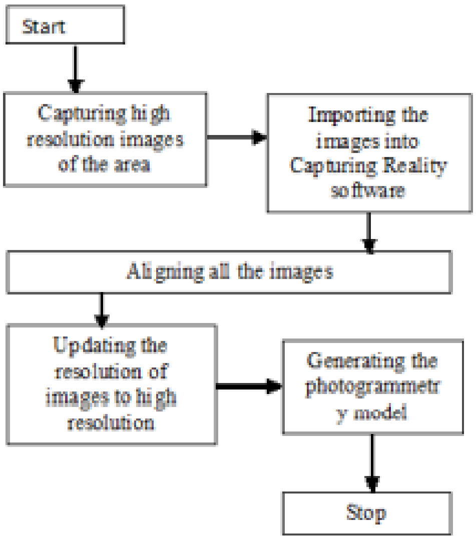

Fig 3.2.4 DFD for Photogrammetry model

3.5 Merging of MATLAB and Photogrammetry Model

The MATLAB model and Photogrammetry model is provided as an input to Finite Element modelling which further processes the two models and generates the precise 3-D model.

The finite subdivides the infinite study area into finite smooth areas and further processes those areas to generate the accurate 3d geological model. The finite element modelling includes certain functions required for interpolation of input model details, and further perform the calculation and generates the required 3d model by merging the input models.

3.6. Block Diagram

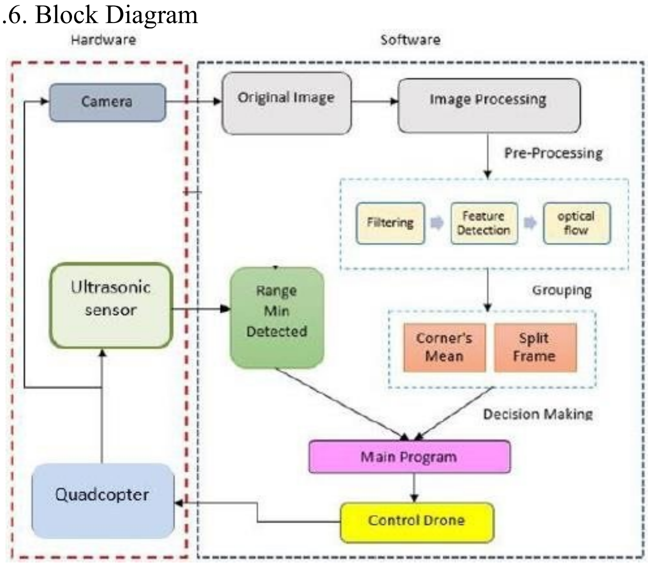

Figure 3.4 Block diagram

3.6 Circuit Diagram

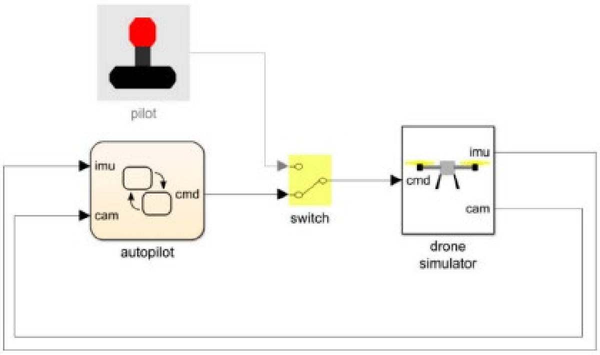

Figure 3.5 Autonomous navigation system developed in Simulink

The autopilot block is the State flow state machine implementing the navigation system; the pilot block manages a joystick in case of manual navigation; the switch block allows the change between with Gazebo.

IV. CONCLUSION

Integration of finite element modelling has increased the efficiency of 3-Dimensional modelling and visualization upto 80-90% optimize. The project has succeeded in providing the benefit of being able to visualize the model in 3-d and thus provided the ability to create photo realistic renderings. The system integrated a model that allowed editing of components separately with higher level of accuracy and the ability to see how components line up against each other. The system provided an ease of prototyping and leveraging existing 3d models to evolve into new concept design.

V. REFERENCES

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