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Nagpur Metro Tracks Construction Monitoring System

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ABSTRACT

An automatic procedure is developed for detection of changes of the metro tracks in Nagpur. As the working progress is still on and monitoring the tracks manually is time taking and exhausting. So the automotive detection of the metro tracks is needed. This application would show the progress of the construction of the tracks in monthly basis and can show the result to the user. The application would show the metro tracks on the basis of the data present in the satellite imagery that will help to monitor the construction of the tracks from non existing tracks to completion of the metro tracks using GIS (Geographic Information System) technology. The approach uses the existing database to force the detection and portrait of the correspondent metro network in the image. At the end the comparison between the old non existing metro track and the existing tracks image will be performed using change detection and the output will be generated.

Key words: Change Detection**,** Geographic Information System **(**GIS),

1. INTRODUCTION

Nagpur is developing city where Metro Rail work is progressing on in full swing. Nagpur Metro is the only metro probably which follows the environment friendly policies, like fulfilling its energy requirement through solar energy up to 65%. Depot boundary walls, The station ceiling, clear terrain areas, will be mounted solar panels to make Nagpur Metro to be the greenplot and encompassment faithful metro in the country.
The primary focus of our study is to identify the challenges and difficulties that we face and to find some feasible solutions while monitoring metro tracks construction in Nagpur, Maharashtra. The metro tracks construction contracts are given to the private contractors that are needed to be monitored by the Government. The manual monitoring process is slow, time consuming and error prone. So an application can be provided to monitor the data at one place and in less duration.

The Metro construction has been sanctioned in February 2014, by Government of Maharashtra and gave approval for metro project. On 31 May 2015, construction of the project began with trial run beginning on 30 September 2017.There are two lines which are being constructed those are orange line (North-South) and blue line (East-West). In this project, we took one station from each line (i.e. Zero mile to Sitaburdi from Orange line and Ambajhari Lake to Shubhash Nagar from Blue line).

In this application we will use GIS. A geographic information system is a system produced to analyze, capture, manipulate, manage, present spatial or geographic data and store. GIS applications are tools that allow users to create interchangeable queries, edit data in maps, evaluate spatial information, and perform the results of all these operations.GIS, combined with project management and financial software, helps you track performance. Geographic Information System helps to constitute all relevant project information, soils, from survey data and geotechnical studies to planning, environmental studies, engineering drawings, and project maps.

Metro tracks are making a crucial contribution to economic development and growth and bring important social benefits. It is beneficial as well as much crucial in order to make a nation grow and develop. Development and the maintenance is the one factor that we need to keep in mind while constructing and tracking the progress of the construction. Whereas to Monitor the progress, we need automotive system so as the system could keep a track of the construction.

In this project, we will use open source desktop GIS software such as Quantum GIS(QGIS), GRASS GIS and Arcmap. These applications will help to use in preprocessing the data. The preprocessed data then be used to detect the tracks with the help of image classification referred in figure 4 and 5. This process will be applied for every images and the output of the images will be compared and will be shown to the user. We took an initial idea from [1],[5],[7],[9].

2. LITERATURE REVIEW

To get the idea of this project, following papers has been referred to understand and implement. The first article by M.

Sester, Fritsch, M. Englich & Dan Klang Shows an Automatic detection of changes in road database which is used to developed for detection of changes between an existing road and a newly registered satellite image, rectified through an orthophoto. This approach uses the existing database to force the delineation and detection of the correspondence of road network in the image. After that each road segment is handled separately while comparing between the image and the database as the position errors are considered to be randomly distributed along the road network. For this they have used "Ziplock snakes" algorithm which is used to optimise the delineation process. The algorithm gradually calculated with the help of Hessian matrix formed by the partial derivatives of a Gaussian filter [1].

Anna Zanchetta and Gabriele Bitelli presents an amalgamation of two unsupervised techniques for change detection in semi-arid and arid areas. The goal of this research paper is to introduce semi-automated reproducible technique to reduce the weakness in change detection of the unsupervised approach and a new time effective. Two techniques has been used, Maximum Autocorrelation Factor transform of Multivariate Alteration Detector components (MAF/MAD) and Change Vector Analysis (CVA) in this paper. The results are applied into two case studies in the Middle East region The research introduces further understanding to the use of both the methodology for accurate change detection that can be used as a fast semi-automatic preliminary step and study of unsupervised procedures. The output of this paper shown the new addition of implementing of CVA for the Geospatial Free and Open Source Software using Grass GIS [2].

Ferdinando Di Martino, Pietro D'Amico and Salvatore sessa "A GIS as a Decision Support System for planning Sustainable Mobility in a case-study", In this article, they have taken an images of American military observation satellites that were used from different sources for detection of changes in landuse. Using diversity parameter, the moving window technique was applied to process the comparable layers from images. The resulting difference have been done where urban sprawl occurs and interpretable change patterns. The distinctions of CORONA images proved to be an additional tool to quantified and analyze major changes in land use. The result gives out an additional basic data eg. in regional planning. The computation sequence was executed in GRASS GIS [4].

Dan He;Jianming Cai, Jing Zhou;Zhihua Wang Urban, In this article they have taken one Land sat5 TM image of 1993 and one Land sat 7 ETM+ image. An integrated GIS and RS approach is used for change detection. Derive from the summery the methods of change detection and visualizing the disadvantages the canonical correlation analysis is introduced. The comparison is been made in two time phases. After that, the database is organized based on the basic space data such as road maps and maps showing present condition of land implementation and urban planning .By Vectorization and spatial overlay analysis the result fix in the image changing detection is entered into GIS for existent data. At the end the acceptance precision is high and urban built- up area is extracted. The dynamic change and the urban extension area are the reasons and aspect in the Tianjin city, it shows that urban planning is implemented and changes of the urban expansion is coincident [5].

Stefan Hinz have worked on the automatic object extraction for change detection and updated some GIS aspects.1. Available image characteristics and sensors 2. Processing time and Effectiveness 3. Automation Level 4.Quality of results and Verification/editing. They have represented these aspects by recent efforts made. Also preventing and supporting the management of natural hazards like flooding and earthquake [6].

Dr. Mushtaq Ganie and Dr. Asima Nusrath they have shown the stepwise calculation flow with the help of ArcGIS 10.2.2 to identify the area 1. Derived using remote sensing data 2. delineation of non-vegetation classes using NDVI threshold 3. supervised classification for the recognition of apple orchards. Using Vegetation index,a non- vegetation classes like wastelands, water bodies, settlements has been masked and 4. unsupervised classification to Delineate forest plantation all these combination of the spectral regions classifies the vegetation with its higher and lower classes.[7]

Weixing Wang, Nan Yang,Yi Zhang, Fengping Wang,Ting Cao And Partik Eklund A Review Of Road Extraction From Remote Sensing Images, In this paper they have extracted the road from several methods and remote sensing. The methods are classified into active contour model, Dynamic programming, classification- based methods, knowledge based methods and mathematical morphology. Then the comparisons of the different road extractions are analyzed [8].

Anagha Deolikar, Dr. Shubhangi Neware, In this paper, they have introduces the concept of Image Processing and Mobile Crowd Sensing, so as to monitor the construction site of Metro environment. Using image processing, it captures the image with the referenced area and the Mobile Crowd Sensing is used to get the image of the construction whose progress activity will be analysed will be captured. The result is shown as an accuracy of designed system which calculates and proves to be precise [9].

3. METHODOLOGY

3.1 Workflow

This System will have two input images that will preprocess the data of the two different years of the same place. And change detection will be done, that will compare the two satellite images and the output will be shown.

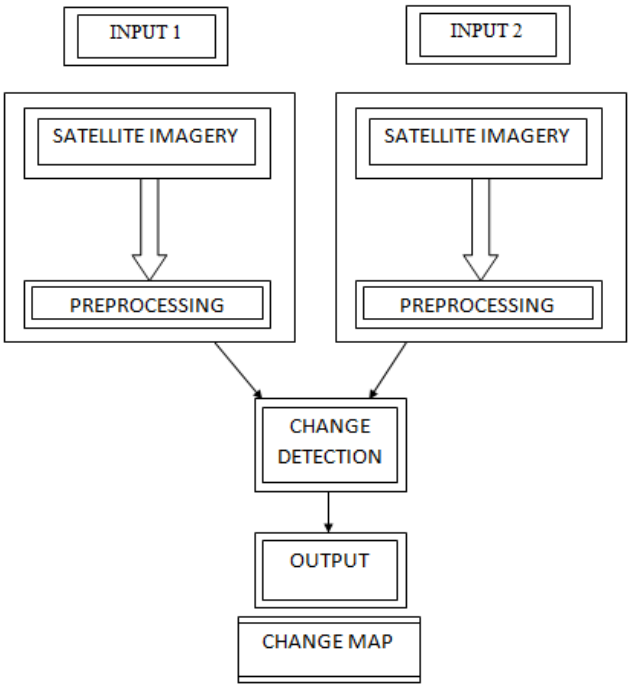

Figure 1: Workflow of the project.

Satellite Images

For monitoring the tracks construction of the Nagpur Metro Station we need the satellite imagery that can help in to update the construction progress. Satellite imagery are images of Earth or any other planet that are captured by satellites operated by businesses around the world and governments. For our project perspective we took the satellite imagery from the online site United States Geological Survey (USGS, formerly simply Geological Survey) is a scientific agency of the United States government. The researchers and scientists of the USGS study the landscape of the United States, its natural resources, and the natural hazards that enforce it. From open access site we registered and logged in to the site and collected the latest data of Nagpur area. Though we have taken the two areas those are Zero mile to Sitaburdi that is the Orange Line and Ambajhari Lake to Shubhash Nagar that is the Blue line. We have downloaded the data according to the data present in it. The satellite imagery we got for this project is of year wise from 2018 to 2020[5].

Preprocessing

After downloading of satellite images, we get a zip folder which have the compressed data in which jp2 extension of images are present. These data are then preprocessed with the help of ArcGIS software and then Georeferencing process is done. Georeferencing means that the aerial photo image can be linked to a ground system of geographic coordinates or internal synchronizes with the system on a map. The applicable coordinate transforms of the image file, are many possible mechanisms for putting into georeferencing. Then it is converted into Tiff format. This allows for a smoother, sharper image and can get the coordinates. Also the file size compared to JPEG is lower for the same quality. Also we took another image from Google earth so that we can take the Vector image from the map. That is, we digitize the track required for our project area Then saving those images will help in extraction from the raster data. Saving the images need to be converted into shape file(.shp). After that georeferencing is donein which the tracks has been extracted from the images with the help of Spatial Analyst tool that will help to extract the mask through the image. Once it is done, then the classification is done so the tracks could be seen in same color[7].

Comparison

Once the preprocessing of images is done, change detection will take place. The change detection will calculate the different time images, that will be done through ArcGIS. To do this analysis we require two images with different time period. And then using image analysis tool we can detect the change between these years. In this project we took the images of the Nagpur area, Sitaburdi to Zeromile from the year May 2018 and Feb 2020. These images will already been classify, will calculate the length of track from the previous year and current year. The output will be shown on the web and the information will be displayed.

4. RESULT AND DISCUSSION

Following figure shows the output of the proposed Approach-

Figure 2: Satellite imagery of Sitaburdi to Zeromile from May 2018 from USGS

Figure 2 depicts the satellite imagery of Sitaburdi to Zeromile from the year 2018 which is taken from United States Geological Survey (USGS),that has been georeferenced with Arcmap, which shows the white tracks that is being constructed and yet to finish.

Figure 3: Satellite imagery of Sitaburdi to Zeromile from Feb 2020 from USGS

Figure 3 depicts the satellite imagery of Sitaburdi to Zeromile from the year 2020 which is taken from United States Geological Survey (USGS), that has been georeferenced with Arcmap, which shows the white tracks as well as the stations is being completely constructed.

Figure 4: Extracted image of the satellite imagery of Sitaburdi to Zeromile from May 2018

In Figure 4, we have extracted the tracks from the satellite imagery of Sitaburdi to Zeromile from the year May 2018 with the help of Arcmap. Using extraction by mask, the tracks are easily visible and understandable and focused on the construction of the tracks since then.

Figure 5: Extracted image of the satellite imagery of Sitaburdi to Zeromile from Feb 2020

In Figure 5, we have extracted the tracks from the satellite imagery of Sitaburdi to Zeromile from the year Feb 2020 with the help of Arcmap. Using extraction by mask, the tracks are visible and are completely constructed. The Figure 4 and Figure 5 will then be compared and the result will be shown in info panel[8].

5. CONCLUSION AND FUTURE SCOPE

The high resolution satellite images with suitable resolution and accuracy and covering a wide area, allow a fully automatic comparison when the metro tracks database describes rural areas. This system will have quick and easy access to information during construction greatly. It will increase efficiency and reduce time spent searching for needed information. It can also be efficient to those cities where metro construction could take place. Using modern technologies like machine learning we can widely use this application for the better visualization on metro networks.

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