Original Research Paper

Earth Science

GPS Survey for identification of flood inundated areas of Hyderabad city during heavy rains occurred during the month of September 2016

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ABSTRACT

The paper describes virtual reality method of collecting data of severely flood affected areas with the heavy rains that occurred during the month of September 2016 for creating a Geographic Information System (GIS) for creating a awareness along with the basic amenities available for the people of low lying areas. The aim of this study identification of low lying areas which are inundated by heavy rains using GPS survey is raised as a priority by providing them the mitigation measures. For this purpose, Hitech city zone extending from Cyber towers to Nijampet was selected and highly water inundated areas were extracted by using Trimble GPS.

KEYWORDS

Introduction

Urban flooding is significantly different from rural flooding as urbanisation leads to developed catchments which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times, sometimes in a matter of minutes. Urban areas are centers of economic activities with vital infrastructure which needs to be protected 24x7.The basic philosophy of urban drainage systems, or "storm water management", for re-directing water flow has been to seek maximum convenience at an individual site by the most rapid possible elimination of excess surface water after a rainfall. In other words, "get that water out of here NOW" has been the overlying philosophy of creating drainage systems in urban areas. Many areas have inundated with rain water due to the flash rains that occurred on 20th and 21st September 2016, in our study we identified the areas which are severely affected due to heavy rains using GPS survey.

There are different ways of acquiring and gathering spatial data. Global positioning system (GPS) receivers are frequently useful for engineering activities in the forest environment and for forest inventory and road inventory (Evans et al. 1992), topography and cadastral forest surveys (Soler et al. 1996, Yoshimura et al. 2002), locating or mapping boundaries to monitor harvesting machinery (MacDonald et al. 2002), geographic information system (GIS) forest applications (Wing and Bettinger 2003), resource and spatial area management (Wing & Kollegg 2004), and forest area and perimeter estimation (Tachiki et al. 2005).

A variety of GPS receiver hardware configurations and satellite systems are now available to consumers to assist in field data collection, reconnaissance, and other activities (Wing et al. 2007). There are three recognized GPS receiver grades: consumer grade, mapping grade and survey grade. Within these grades, the consumer GPS receivers are quicker and easier to use for gathering position digitally, compared to other available devices (Rodríguez-Pérez et al. 2007). Mapping grade receivers are considered the best suited for forestry purposes but they are usually unavailable in forest management plans due to higher cost (20 times) compared to consumer receivers (Wing et al. 2007). Another alternative to gain the data is surveying technique. Before the advent of GPS, surveying techniques were utilized for mapping. Surveying (also known as land surveying) is the technique and science of accurately determining the terrestrial or three dimensional position of points and the distance and angles between them (Tamadoni 1987).

Surveying has many restrictions when used to collect measurements in natural environments. Trees commonly create barriers along measuring areas, while forest topography can also be problematic. Also, errors in surveying technique are accumulative and cause increased errors at the end of a path. There are also several likely sources of error associated with GPS which include: signal interference due to atmospheric conditions, the synchronization of satellite and receiver clocks, and tracking of satellite position and patterns (Leick 2004). However, the GPS errors are less user-dependent. Forested landscapes place significant impediments to collecting resource measurements through the canopy, understory vegetation, land forms, and other factors that block satellite signals from reaching a GPS receiver (Wing et al. 2007). The main concerns of using a GPS receiver in natural environments are the availability and characteristics of satellites under the forest canopy (Rodríguez-Pérez et al. 2007). Branches, trunks and leaves attenuate, distort or brake GPS signals within a forest stand; hence accuracy and location are markedly lower than in area with un-obstructed sky conditions (Hasegawa & Yoshimura 2003).

A number of studies were done to reduce the location errors of GPS receivers. Differential Global Positioning system (DGPS) improves accuracy and precision in forest environment (Hasegawa & Yoshimura 2003, Sawaguchi et al. 2003, Satirapod et al. 2003). However, DGPSs are not available for consumer GPS receivers, which are cheaper, easier to use, and require less user training than DGPS receivers.

Hyderabad Flooding

The city of Hyderabad was founded by Mohammed Quli Qutub Shah on the southern bank of Musi River in 1591. Hyderabad is situated in the Deccan plateau, at an elevation of 536 meters above sea level. The city lies between 17.366°N latitude and 78.476° E longitude. The landscape of the city is dominated by hills, tanks, forests and rock formations. Soil type is mainly red sandy interspersed with areas of black cotton soil.

Hyderabad experienced heavy rainfall in various parts of the city early on 20th and 21st September 2016,with flooding at some places.A flood-like situation prevailed at Kukatpally, Alwal, Qutbullapur and Malkajgiri, with thunderstorms leading to continuous rainfall throughout the night. Qutbullapur experienced15.6 cm of rainfall, and along with Alwal and northern part of Kukatpally, was put on high alert. In Kukatpally, the rain reduced in intensity after 3 hours, though the high alert stayed in place.Toli Chowki and Shaikpet areas also experienced heavy rainfall. Toli Chowki and Shaikpet areas also experienced heavy rainfall. The Nalla at Allwyn colony overflowed as a result of heavy

rainfall, and Chikkadpally and Nallakunta nallas also experienced increase in water level on Wednesday. A wall collapsed at Ramki villa due to the rains. The Ganesh Nagar nalla, Ayodhyanagar, Dwarkanagar, Subhash Nagar and Devendra Nagar were some of the low-lying areas inundated by flood waters. Additionally, water had stagnated at Surraram, Chintal, Venkateshwara Nagar, Sudarshan Nagar, Bhagatsinh Nagar and Maruti Nagar. At Qutballapur Circle, the Vennalagadda tank discharged surplus water which flowed into the nalla, inundating nearby colonies like Ganesh, Venkateshwara Nagar, Srinivasa Nagar, Manikya Nagar and Venkanna hills. Officials said that if the flow from the nalla recedes, the stagnant water will recede from the mentioned areas in a couple of hours.
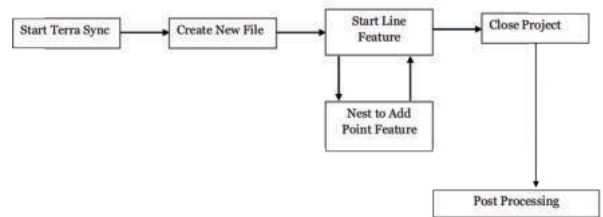
Methodology
Terra Sync Software

Software designed for efficient field GIS data collection and maintenance. Quick Point data collection mode for easy productive one-click data capture. Optimized for Trimble handhelds with integrated digital cameras. Support for centimeter-grade RTK receivers. Conditional attributes for dynamically adapting data capture forms. Customizable user interface simplifies field operation. Smart data maintenance. Seamless GNSS control in the field for high quality position data

Start TerraSync from the Start menu. Tap the window icon, and then select Programs/TerraSync. Move to where the receiver has a good sky view. Use the Data area to create files and and capture features with the GPS. Ideally, prepare a data dictionary in advance to facilitate efficient and accurate feature collection. You can also create a data dictionary in the field. (The default data dictionary is ok for generic points, lines and polygons.)

Collect a series of GPS points as a new file:
- Go to Data view.
- On lower pull down, select New.
- Set the location folder, provide the file name, and select a dictionary that has been created.
- Click Create.
- Specify the antenna height to estimate how high you will hold it above the ground, here we are holding it 1m height but the vertical accuracy is probably at least 5 m, so this isn't so critical.
- You should see a Create button with a round blue symbol, and also a selection of feature types: point, line or area. Once your GPS is positioned and steady (use the bubble level) at a point you want to collect, you can either click the button or double-click the feature type to create a new point.
- At this point data will start to collect (unless you have Log later set) – you'll see positions accumulating in the top bar with a pencil drawing thing and a count of positions also displaying the post-processing accuracy to expect.

  - While you are collecting data, shown as numbers incrementing to the left of the window close X button, we have to enter in a Comment, or any other attributes, in the fields shown. You probably want to collect a lot of positions to average for accuracy, so you probably have plenty of time to enter useful attributes.
  - If you're not at the point, unless you are using log later you may want to pause right away if you're not ready to collect positions. You can then press the same button to start or resume logging when you're ready for the positions.
  - You can collect data in the Map View as well as the Data View. In the map view, the create feature button will just be a small blue solid circle.
  - Note that the unit will continue to log between features collected. You can pause and restart this as you go.

- Use the map view to see what you're collecting, while you're collecting it. You can create new feature objects while in the Map View, though the data interface is less complete than the Data interface. See the map section below.
- Close the file. There's a close button. Pretty obvious. There's also a window closing X that exits the whole program

Flow Chart describing the methodology of GPS locations

Results and discussion

GPS data files used by Terrasync are not readable in ArcGIS, so we'll export to shapefile format. We must do this correctly to ensure the data have the attributes we want and are in the correct projection. To export, go to Utilities/Export, to bring up the Export window. The results are shown in the figure below; also from the above studies it is observed that the Izzatnagar colony which is nearer to the hitech city railway station is extremely inundated with flood water. It is necessary to take necessary to take mitigation measures in order to minimize the loss.

Figure 1 : Showing raw GPS data