Re-Alignment Proposals for an Existing Rural Road Network Using PPK DGPS Technique: A Case Study

D. Pruthvi Raj, K. Rajasekhara Reddy

Abstract: ***This project work has been intended to explore effective and economic methodologies in Rural Road network planning. Test sites are identified based on the demographic details pertaining to Yadadri District of Telangana state in India. This project work has been initiated to develop a methodology to provide new rural road connectivity to these habitations, which are not benefited under Pradan Mantri Gram Sadak Yojana. This study considers factors such as route selection, study of socio-economic profile, topographic surveying techniques, image processing of Google maps, and proposing new road alignments on to the topographic sheets of the study area. This Newly proposed road is connected either to the adjacent habitation which has better transportation facilities or to an All Weather Road (AWR) in the mandal, like (State Highways, National Highways, Major District Roads and Other District Roads).These newly proposed alignments through these locations are surveyed using Post Processed Kinematic Technique Differential Global Positioning System (PPK DGPS) topographic surveying and a few guidelines are proposed with their economical considerations which suit best for rural road network planning. Finally, the above recommended method has been verified and compared by conducting a pilot study on a road section which has already been proposed and estimated for construction of an AWR by the Panchayat Raj Department of Bhonigir Division, Yadadri.***

Index Terms: ***Rural Roads, DGPS, PPK, GCP's, PMGSY.***

I. INTRODUCTION

Rural road connectivity in Andhra Pradesh is poor. The initial idea was to improve the rural road connectivity in the study area by suggesting economic methodologies in planning and surveying. Identification of the constraints faced in conventional methods of planning and whether these constraints can be eliminated by using modern technique in rural road network planning by using topographic survey and differential positioning systems as an effective alternative. [1].

II. RESEARCH SIGNIFICANCE

This project was intended to explore effective and economic methodologies in Rural Road network planning. The study considers factors such as route selection, socio-economic profile study, topographic surveying techniques, updating the data on to the Google maps or on satellite images related to the concerned study area or mandal. [2]

III. LITERATURE REVIEW

Recent techniques used for topographic survey using DGPS are also studied in order to attain accuracy about the alignment details.

Method of Conducting Topographic Survey Using Differential Global Positioning System is Static Method. In this method, initially installation of base station at a point in the area to be surveyed is setup. Then a rover GPS receiver system is taken and control points are taken around the base station. This procedure needs around 10 minutes per each control point reading to be considered. The data so collected is recorded in the DGPS instrument used for survey.The data processing is done by an individual software package and required parameters are obtained [3].

IV. OBJECTIVES

- Selection of remote villages and habitations in different mandals of Nalagonda district as study area to locate new alignment proposals in order to develop the rural road connectivity.
- To conduct field surveys for the above selected Ground Control Points GCP's in habitations to be connected with existing nearby Major district roads/State highways/National highways using Post Processing Kinematic technique.
- To analyze the PPK Differential Global Positioning System data with reference to the GCP's and to impose the above parameters of the proposed alignment data on the Google maps and to indicate the new proposals of the rural routes and alignments on the Mandal core network maps.

V. IMAGE PROCESSING

The following are the sequence of operations made by canny method of Image processing [4].

- Smoothing
- Differentiation
- Nonmaximal Suppression
- Thresholding

A. Smoothing

The image is processed by the Gaussian filter to eliminate noise (eg: small dots).

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D. Pruthvi Raj, Research Scholar, Department of Civil Engineering, , Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.

K. Rajashekhara Reddy, Associate Professor, Department of Civil Engineering, , Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.

B. Differentiation

Used to identify the edge between two homogeneous areas with different intensity. Using this Angle of gradient and magnitude are calculated.

C. Nonmaximal Suppression

Use to locate edges at the pixel values with maximal gradients and mark the areas of different brightness.

D. Thresholding

Canny edge detector use double intensity thresholds (lower and upper limit) to decide which edges are significant.

VI. CANNY METHOD

Following are the examples with natural imagery. In the first case, we have a road way scene where the road surface is obstructed in tree shadow.If we want to find the true edge of the alignment and edge indicator (eg: Canny) cannot remove this information very well, as shown in below [5].

VII.EDGE DETECTION TECHNIQUE

Image processing is done on the Google image after the alignment is imposed on the Google maps. This procedure employed gives a clear idea about the location of point on either sides of the road. This technique is called edge detection.

Technique of edge detection is used in the study to get a clear idea about the actual location of the road and location of verification points around the road section. it is successfully detected all the points which are the Landmarks beside the road have been exactly posted , therefore the reliability on topographic survey has been justified [5].

VIII. GAUSSIAN FILTERING

A Gaussian is an ideal filter in the sense that it reduces the magnitude of the high spatial frequencies in an image proportional to their frequencies. That is, it reduces magnitude of higher frequencies more.

This will be at the cost of more computation time when compared to main filtering [6].

IX. METHODOLOGY

Fig. 1 shows Trimble R3 receiver & choke ring A3 antenna, Table I shows Ground control points (GCP's) collected in rajapet, b. ramaram & turkapally.

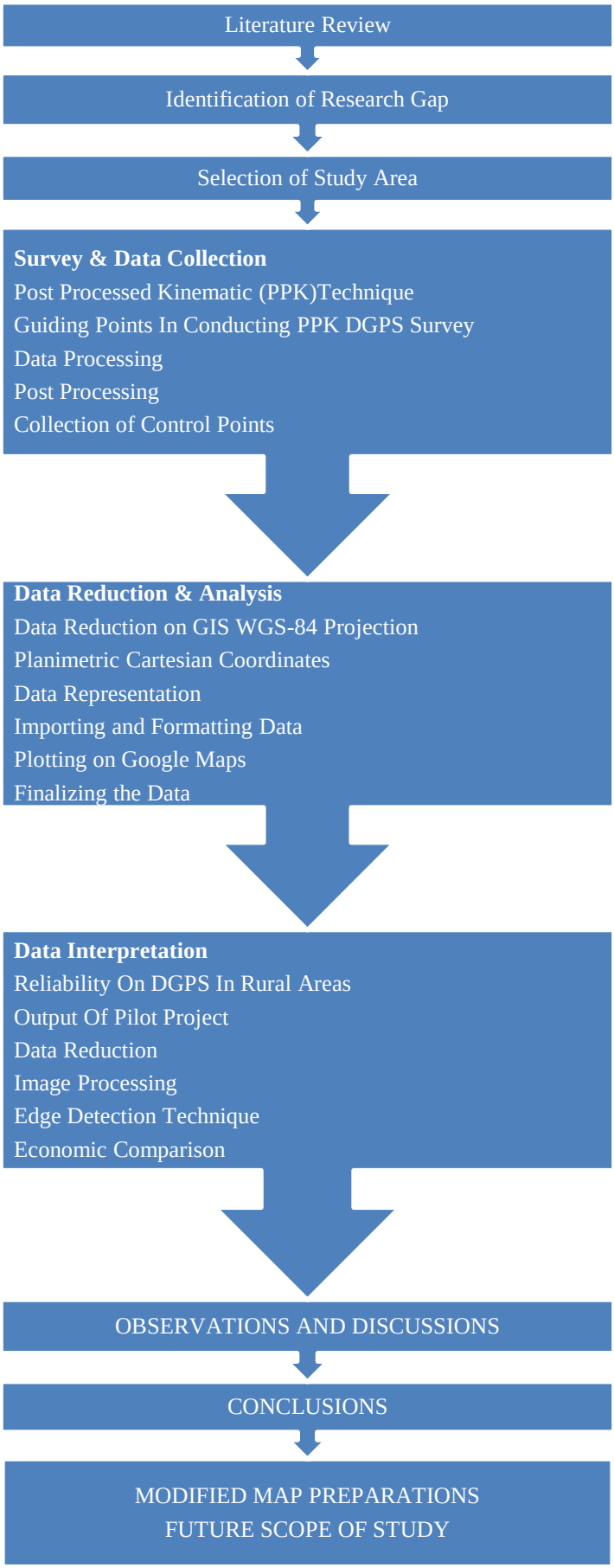

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Fig. 1: Trimble R3 receiver & choke ring A3 antenna

Table I: Ground control points (GCP's) collected in rajapet, b. ramaram & turkapally.

Point Id	Latitudes	Longitudes
Base	$17^0$72826'	$78^0$91965'
Base2	$17^0$67985'	$78^0$92460'
Bondugula	$17^0$76961'	$78^0$96639'
Bondugula2	$17^0$76823'	$78^0$96624'
Gandamalla	$17^0$72738'	$78^0$85633'
Gandamalla1	$17^0$72737'	$78^0$85634'
Gandamlla	$17^0$72737'	78.85634'
Kolanpaka1	$17^0$69555'	$79^0$03305'
Malla1	$17^0$77809'	$78^0$87742'
Molla2	$17^0$77804'	$78^0$87794'
Renikunta1	$17^0$71689'	$78^0$91060'

Fig. 2(a): GCP's plotted on google maps related to rajapet mandal

Fig. 2(b): New alignment proposal b/w narsapur and mallagudem

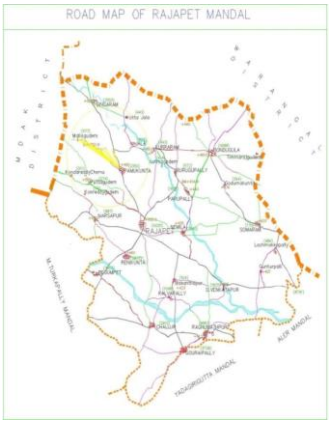

Fig. 2(c): New alignment proposal b/w narsapur and mallagudem

Table II: GCP's collected in bommala ramaram mandal

Point Id	Latitude	Longitude
Kondamadugu1	$17^0$48971'	$78^0$76841'
Kondamadugu2	$17^0$48817'	$78^0$76971'
Marilala Base	$17^0$56383'	$78^0$81219'
Ramlingampally1	$17^0$57836'	$78^0$69799'
Ramlingampally2	$17^0$57510'	$78^0$69927'

Fig. 3(a): GCP's plotted on bomalla ramaram Google maps

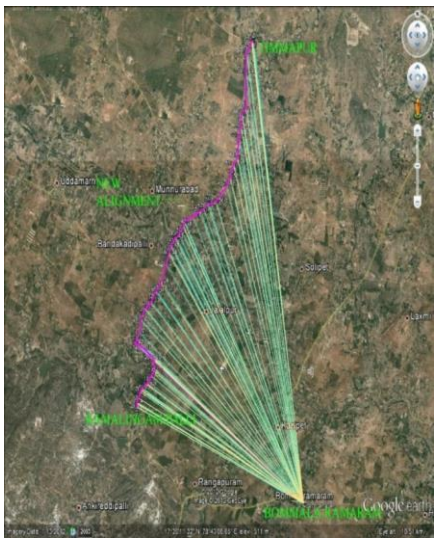

Fig. 3(b): New alignment proposal b/w timmpur and ramlingampally

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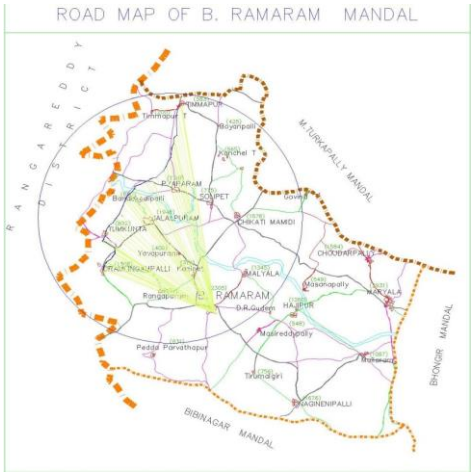

Fig. 3(c): Core road network B. ramaram

Fig. 4(a): GCP's related to turkapally mandal

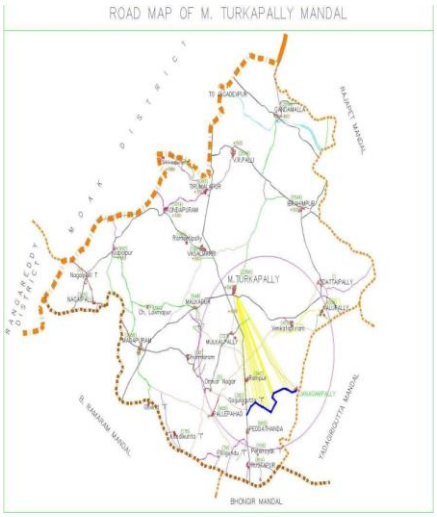

Fig. 4(b): GCP's plotted on turkapally google map

X. ECONOMIC COMPARISON

The estimates of road network related to pre feasibility study are considered and the financial details of topographic survey and convention survey conducted on the Yadigirigutta PWD road and Mallagudem are compared to know reliability factor. The criteria'a on which the comparison is done between two methods involved in surveying are as follows:

a. Financial requirements
b. Accuracy
c. Mobilization
d. Man power required
e. Time consumption
f. Technical limitations

Table III: Financial Comparison of conventional & Topographic survey

S.No	Description	Rates Rs / day	Conventional Survey	Topographic Survey
1	Time taken to survey selected road section		5 Days	2 Days
2	Surveyor	400 Rs / day	5 x 400 = 2000 Rupees	2 x 400 = 800
3	Mazdoor Skilled	215 Rs / day	5 x 215 = 1075 Rupees	Not required
4	Mazdoor un-skilled	215 Rs / day	5 x 215 = 1075 Rupees	Not required
5	Mazdoor semi skilled	215 Rs /day	5 x 215 = 1075 Rupees	2 x 215 = 430 Rupees
6	Instrument allowances	3000 Rs / day	5 x3000 = 15000 Rupees	2 x 3000= 6000 Rupees
7	Mobilization	300 Rs / day	5 x 300 = 1500 Rupees	2 x 300 = 600 Rupees
8	Messilinous charges	150 Rs / day	5 x 150 = 750 Rupees	2 x 150 = 300 Rupees
9	Total Expenditure		22,475 /-Rupees	8,130 /-Rupees

XI. SUMMARY

Topographic surveying using DGPS is being used frequently Now a days. The key criteria's related to these two methods of surveying are compared and the results are balanced .Each technique had it limitations.

The conclusions of these pilot study is that topographic surveying using DGPS can be most efficient while surveying long section (>50KM) of rural roads in remote area because the Presence of Dense Forest, Mobilization of man power, financial inputs are some of the tough tasks to control .Topographic survey needs limited resources and the results of this survey are accurate enough. The fact that Topographic surveying can be done in the absence of day light makes more reliable technique for rural road network surveying.

XII. OBSERVATIONS

After examining a number of habitations, some were excluded because they possessed geometric irregularities. The sites selected for data collection were Timmapur, Jangompally, and Mallagudem in the Mandals of Bomalla Ramaram, Turkapally and Rajapet respectively.

A pilot study is made on a road section between Yadigirigutta – Cheriyala PWD road at Mallagudum of 03km length.This investigation is done to determine the suitability of topographic surveying in remote rural areas. Number of crucial conclusions was drawn after the pilot study is conducted.

XIII. INTERPRETATION OF RESULTS

The following are the Conclusions drawn from the present study.

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1. PMGSY scheme connects road network through the habitations with populations more than 500 people according to 2000 censes. Considering 2011 censes selection of under developed habitations has been done to improve their rural road connectivity.
2. Topographic survey is more efficient method for surveying the road alignment located in the remote area were Presence of Dense Forest, Mobilization of Man power and Financial Expenditures are the most uncontrollable tasks.
3. A pilot study made on a road section indicated the facts about controlling the crucial task such as (mobilization, financial needs, etc…).topographic surveying using DGPS can be effective in overcoming the limitations and also the outputs can be possessed as quickly as possible.
4. Reliability on topographic surveying in rural area is very high because of the fact that DGPS can be used in the absence of Day light yet the results are accurate enough, the factor such as time consumption, financial inputs can be drastically reduced when compared to other methods of surveying.
5. From the pilot study we had concluded that usage Total Station for surveying in some typical horizontal sections of the alignment and low-lying area in the route helps in investigating need of proposing construction of culverts and bridges, this data can be included in the results of topographic survey to make this type of surveying 100% reliable.
6. Government Of Andhra Pradesh is releasing huge funds dedicated towards Pre-Feasibility study regarding new proposals of rural road sections, the initial part of the investigations such as Reconnaissance Survey and Preliminary Survey can be effectively conducted using DGPS, As a Result, The expenditure related to the Pre-Feasibility study can be reduced to a large extent.
7. The results of the two surveys are closely monitored and the key components are compared to grade the degree of reliability on DGPS in these remote and rural areas. . As a part of pilot study, results of the conventional and the PPK DGPS surveyed maps were closely monitored and the key components were compared, which indicate the suitability of the DGPS surveys for new alignment proposals of future rural road network development in India.

XIV. FUTURE SCOPE OF STUDY

Data collected is processed in Trimble Business Centre software .this data comprises of the space coordinates of each point taken on the alignment edges, the following data is also imposed on Google maps in our study .Usage of ERIDAS software make image more geo- spatial. Using GPS data, As per the WGS 84 DATUM. The Geo-referencing is done throughout the alignment proposed to understand the terrain conditions in an around the Newly Proposed Alignment.

Data collected can also be imposed on the real satellite images provided by IRS related to the area were the alignments are located. Similarly on Topographic sheets.

The data collected under the study can be submitted to the Panchayat Raj Department, Bhonigir Division. so that, If in the near future any new proposals of road sections are to be made in these Habitations. This data can be considered for the clear investigation in order to materialize the construction of road.

XV. APPENDIXS

STEPS OF OPERATION

Post Processed Kinematic is Used for Collection of Topographic points or ground control points, Detail survey, Contour mapping etc…

PPK Method: In this method both the base station and rover should be manually controlled for collecting accurate ground control points, steps to operate at these particular points are given

Base station

- Files - Job file name - enter name - Select project datum like WGS 1984 , 44 UTM - Accept
- Configuration - Survey styles - select base options - 1/2 PPK - controller - enter logging interval - Enter mask - 2/2 Antenna height - antenna phase center - Accept
- Survey - start base receiver - Point name - antenna height - antenna phase center- start
- Press End (When rover is stopped and survey ended for the day)

Rover

- Files - Job file name - enter name - Select project datum like WGS 1984 , 44 UTM - Accept
- Configuration -i) Survey styles - select Rover options -1/2 PPK - controller - enter logging interval - Enter mask - 2/2 Antenna height - bottom of antenna mount - Accept
- Configuration - Survey styles – select PPK - Initialization time - 1/2 enter time of observation like 10 min or 30 min - 2/2 10 min or 30 min
- Survey - start Survey - initialization – yes – Point name - observe till initialization gains – store
- Survey- Measure points - Point name - antenna height - Bottom of antenna mount- measure
- Observe control points in same way as steps for collecting no. of points.

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AUTHORS PROFILE

Dr. K. Rajasekhara Reddy received doctorate in Geology from Karnatak Universty, Dharwad. He has put up 16 years of industrial experience in manufacturing of ceramic tiles in various areas of operations at different levels and 10 years of academic experience in Koneru Lakshmaiah Education Foundation (Deemed to be University). His interests are exploring alternate low cost sustainable ceramic raw materials, developing economical ceramic tiles.

D Pruthvi Raj received post graduation in Transportation Engineering from Osmania University, Hyderabad. He has a put up 2 years of industrial experience in construction of high-rise buildings, residential buildings and residential apartments as a Quantity surveyor cum Site Engineer and 4 years of academic experience in Vaagdevi College of Engineering Warangal. His interests are exploring alternate sustainable solutions for all types of Transportation problems encountered in planning and execution.