Comparing the Efficacy between OneCeph digital software versus Manual Cephalometric Tracing.

Nirali Faliya, Mamatha J., Jigar Doshi, Pratik Gandhi, Liyakat Mathakiya, Priyanka Bind

Department of Orthodontic and Dentofacial Orthopaedics, College of Dental Science and Hospital, Amargadh, Bhavnagar, Gujarat, India.

Abstract

Background: Cephalometric tracing is like undetachable method in Orthodontic treatment planning. Cephalometric tracing is used for case diagnosis, treatment planning, evaluation of treatment progress, and growth evaluation. Usually lateral cephalograms are traced by manual method using acetate sheet but now this is the era of technology therefore various digital methods are used for cephalometric tracing. In digital method, various computerized softwares are available and in this generation of mobile phone without which imagination of life is impossible: there is a different android based application also available for analysis during orthodontic treatment planning. This study is to assess the reliability of android based application with compared to manual tracing by Tweed analysis.

Aim: To compare and assess the reliability of android based application for cephalometric tracing with manual tracing by using Tweed analysis.

Materials and Methods: A total 40 lateral cephalogram are randomly taken of 18-25 years of age group which came to department of orthodontics and dentofacial orthopaedics. Tweed analysis is carried out by manual tracing in which incisal mandibular plane angle, Frankfort mandibular angle and Frankfort mandibular incisal angle were measured. After the completion of manual tracing, these angles were measured in android based application and compared with the manual tracing to assess the reliability of this android based application.

Result: The values showed no significant difference in distribution, so that the parametric test like paired t-test and pearson co-relation were performed to analyze the data. It shows no statistical difference between the values of Tweed analysis performed by manual method and android based digital method.

Conclusion: This study shows that the digital tracing with the android based application had equal accuracy in comparison to the manual tracing.

Key words: Cephalometry, Hand tracing, Digital tracing, Tweed analysis

Introduction

Orthodontics and dentofacial orthopaedics is the branch greatly dependent on evaluation and tracing of Lateral cephalogram. In 1931, Broadbent in USA and Hofrath in Germany simultaneously presented a standardized cephalometric technique using a high powered X-ray machine and a head holder called a Cephalostat or cephalometer.[1] Cephalometric analysis has been widely used since then in field of orthodontics for case diagnosis, treatment planning, evaluation of treatment progress, evaluation of treatment results, and prediction of growth and can also be used to predict the surgical outcome for treating dentofacial deformities. Such cephalometric analysis can be performed with manual method or digital method.

Manual cephalometric analysis is executed by identifying radiographic landmarks on acetate sheet and quantifying the linear and angular values with a protractor and ruler. There are the high chances of error because of limitation in identification of various landmarks with angular and linear quantification in lateral cephalogram. Recently, there has been a hike in the utilization of more incipient mechanics in all aspects of our lives. With the quick advancement of computer radiography, manual method is gradually superseded by the digital method. Many cephalometric programs have been introduced to perform computer- aided cephalometric analysis by digitizing the landmarks. The Dolphin imaging software (Dolphin Imaging and Management Solutions, Chatsworth, CA), was the first digital innovation that was employed in the orthodontic field which was introduced in 1994[2].There are various other softwares available now a days for digital cephalometric tracing to assess the legitimacy and reproducibility of linear and angular measurements by the programs such as Quick Ceph 2000 (Sarasota, Florida, USA),[3] NemoCeph (Madrid, Spain),[4] FACAD (Beilkegaten, Linkoping, Sweden)[5] Vistadent (Woodbridge, Canada),[6] and OnyxCeph Software (Neidelwaldstr, Chemitz, Germany).[7]

Utilization of digital radiographic systems is being favoured now a days, as it offers several advantages over manual cephalograms; swift execution of measurements, easy determination of treatment plans, eradication of chemical and other environmental hazards, easy storage of images, and also it can be easily duplicated and can send anywhere in the globe easily.[3] In integration, it is further possible for cost- efficient replication of radiographs as well as its rapid superimposition.

Dr. Charles H. Tweed established the diagnostic facial triangle to determine the normal bucco-lingual position of the teeth in relation to their corresponding jaws. Tweeds analysis consists of three planes that form a diagnostic triangle.[8] The planes

used were Frankfurt horizontal plane, mandibular plane, and long axis of the lower incisor. However, the triangle is formed by the three angles, which are Frankfort mandibular angle (FMA), Frankfort mandibular incisor angle (FMIA), and incisor mandibular plane angle (IMPA).[8]

Very few studies are in literature regarding the android- based cephalometric tracing. As this is the era of smartphones which is become inseparable unit in human life & not use only for phone calls. Besides computer-availed cephalometric analysis software, smartphone application to carry out various cephalometric analysis has been developed which are fast and simple to utilize.At present cephalometric analysis software in the application form can be downloaded on smart-phones that can be acclimated to carry out various cephalometric analysis.

The aim of this study is to assess the reliability of the android smart-phone based application with the manual tracing using Tweed analysis.

Materials and Methods

Forty cephalometric radiographs were arbitrarily obtained from patients of aged between 18-25 years who have visited to the Department of Orthodontics and Dentofacial Orthopaedics, Amargadh, Bhavnagar, Gujarat. The informed consent of the patients has been taken and the study is approved by the ethical committee of the institute.

Inclusion Criteria:

- Good quality radiograph to permit the identification of landmark
- Radiographs from the same machine

Exclusion Criteria:

- Poor quality radiograph of patients with craniofacial deformities
- Radiograph of patients with unerupted or missing incisor

The good quality lateral cephalogram of forty patients were collected who have visited to the Department of Orthodontics and Dentofacial Orthopaedics, Amargadh, Bhavnagar, Gujarat between the age group of 18-25 years with all the permanent incisors erupted.

The Advapex machine was used to take lateral cephalogram. These cephalometric radiographs were first manually traced using a 0.5 mm mechanical lead pencil onto 0.003-inch acetate matte tracing paper taped to the digital hard copy cephalogram sheet of acetate on a view box with the tracing paper properly positioned over the radiograph.

Six landmarks were marked on each radiograph, and three parameters were utilized:

- Incisal Mandibular Plane Angle (IMPA),

- Frankfort Mandibular Angle (FMA), and
- Frankfort Mandibular Incisal Plane Angle (FMPA)

Tweed analysis diagnostic triangle was composed of each radiograph [Figure 1]. All landmarks were traced by single examiner to avoid bias.

OneCeph digital cephalometric tracer was downloaded from Google Play Store in the android phone; same six landmarks were marked on each radiographs, and three parameters or angles, namely:

- Incisal Mandibular Plane Angle (IMPA),
- Frankfort Mandibular Angle (FMA), and
- Frankfort Mandibular Incisal Plane Angle (FMPA)

Tweed's triangle was made by marking the points in the android based application [Figure 2].

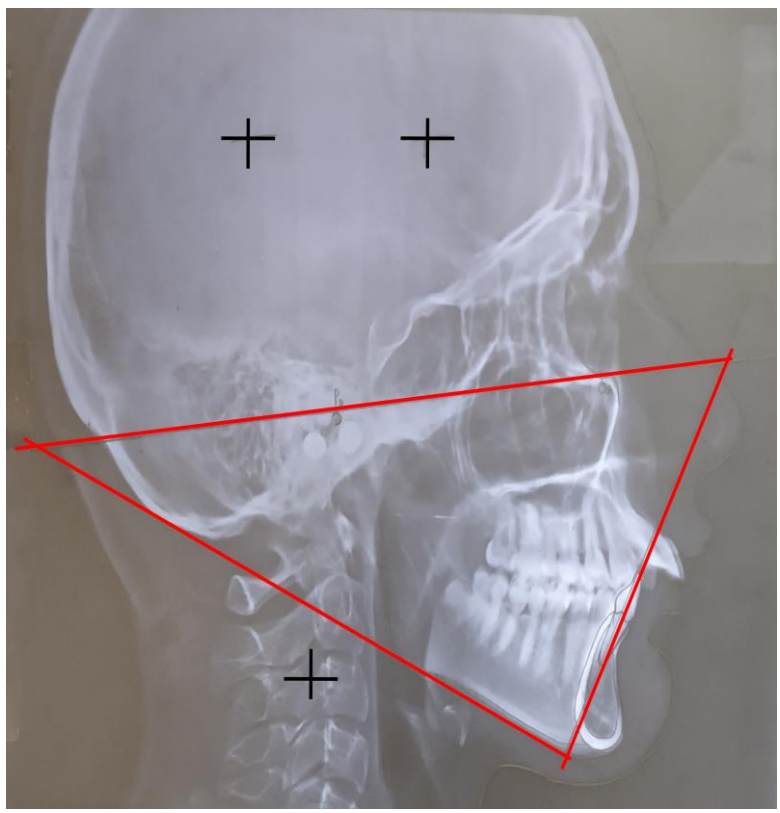


Figure 1: Tweed analysis diagnostic triangle was composed by manual tracing

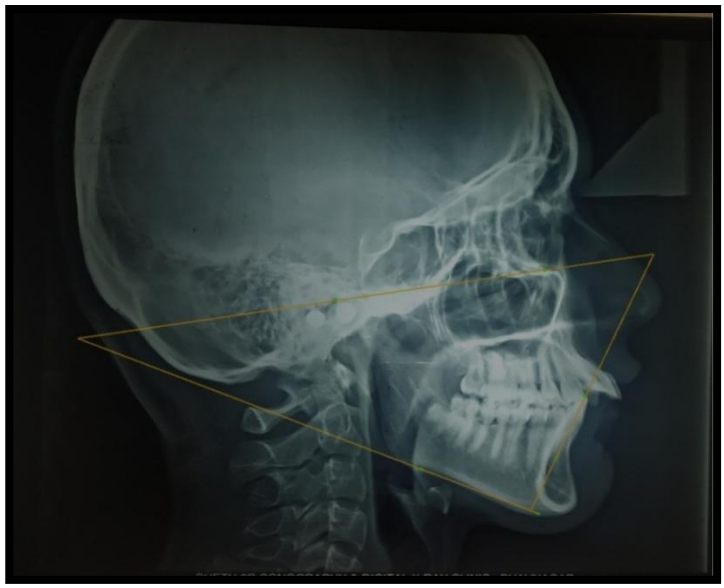


Figure 2: Tweed triangle was made by marking the points in the android based application

The values obtained by each methods; manual and digital were tabulated, and all values were then analyzed using Statistical Package for the Social Sciences version (SPSS 20.0)

A descriptive and analytical statistics were done. The data were represented in terms of mean and standard deviation. As the data followed normal distribution, parametric test was used to analyze the data

Result

Paired t-test:

Table 1: Comparison of mean incisal mandibular plane angle, Frankfort mandibular incisor angle, and frankfort mandibular angle values obtained from the manual and digital OneCeph analysis

		N	Mean ± SD	Mean difference ± SD	t	*p* VALUE
Pair 1	Manual FMIA	40	55.16±9.87	0.26±0.88	1.89	0.067
	Digital FMIA	40	54.9±9.77			
Pair 2	Manual IMPA	40	100.7±9.68	-0.24±0.61	-2.51	0.016
	Digital IMPA	40	100.94±9.51			
Pair 3	Manual FMA	40	24.23±6.84	0.12±0.68	1.13	0.265
	Digital FMA	40	24.1±6.75			

On comparison of the mean values of Manual FMIA and Digital FMIA the mean values of Manual FMIA is higher with a difference of 0.2625 is statistically not significant with a *p* value of 0.067.

On comparison of the mean values of Manual IMPA and Digital IMPA the mean values of Digital IMPA is higher with a difference of 0.2425 is statistically significant with a *p* value of 0.016.

On comparison of the mean values of Manual FMA and Digital FMA the mean values of Manual FMA is higher with a difference of 0.1225 is statistically not significant with a *p* value of 0.265.

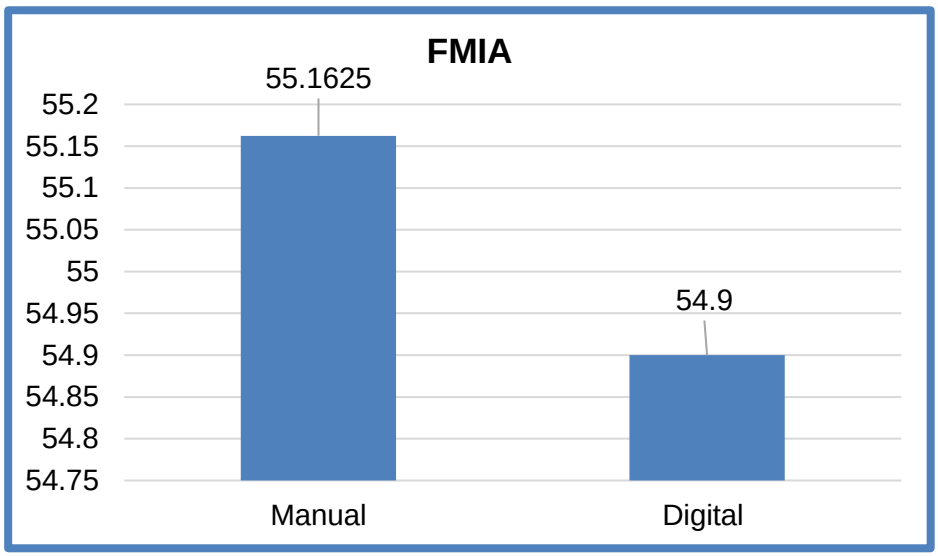


Chart 1: On comparison of manual tracing and digital tracing, there was no significant difference seen as in manual tracing, the average value of Frankfort Mandibular Incisor Angle (FMIA) is 55.1625 where with digital tracing it was 54.9 which is indicative of no difference in it.

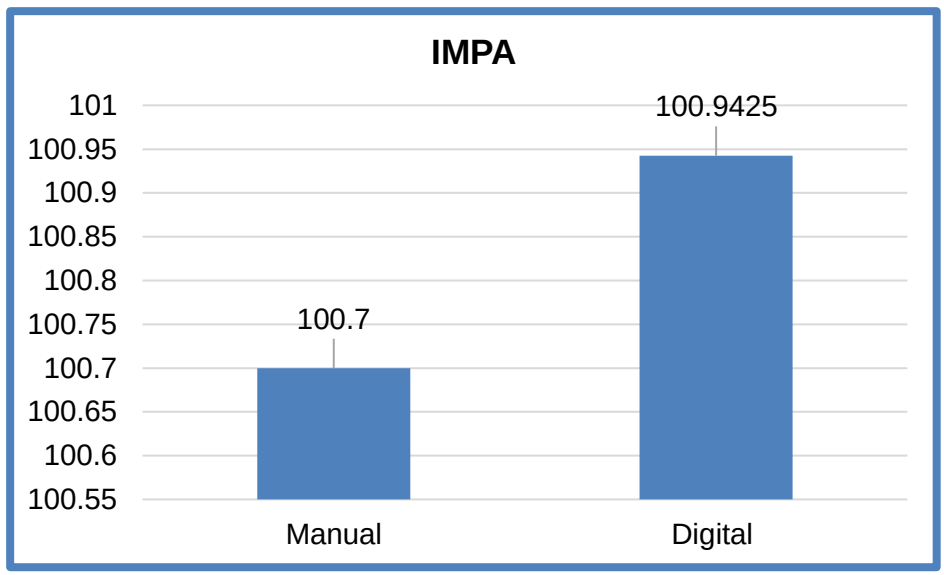


Chart 2: Comparison of Incisor Mandibular Plane Angle (IMPA) shows almost equal average value with manual and digital tracing which is 100.7 and 100.9425 respectively.

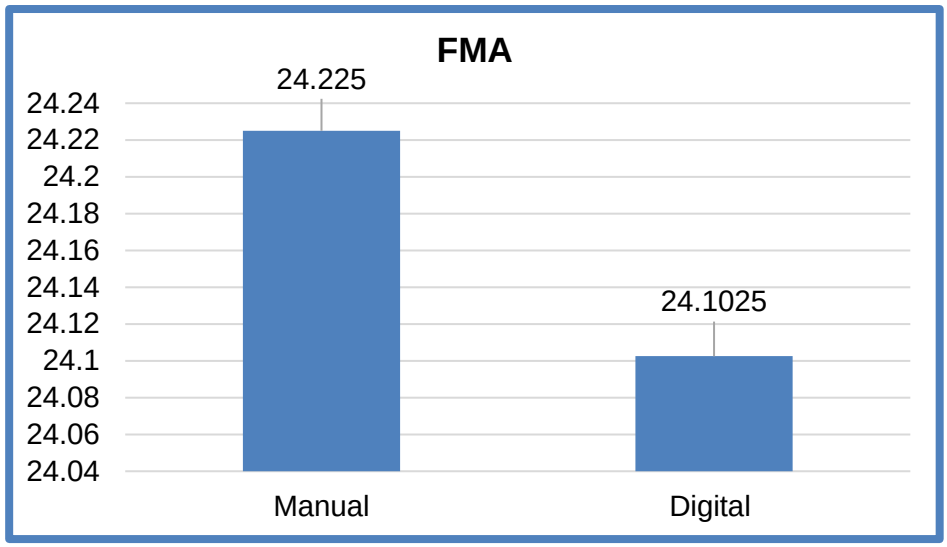


Chart 3: Comparison of Frankfort Mandibular Angle (FMA) suggestive of no significant difference between manual tracing and digital tracing with the value of 24.225 and 24.1025 respectively.

Pearsons correlation:

Table 2: Comparison of mean values obtained from the manual and digitalOneCeph analysis

Sr.no	Parameters being correlated	N	Correlation(r)	*P* value
1	Manual FMIA & Digital FMIA	40	0.996	<0.001
2	Manual IMPA & Digital IMPA	40	0.998	<0.001
3	Manual FMA & Digital FMA	40	0.995	<0.001

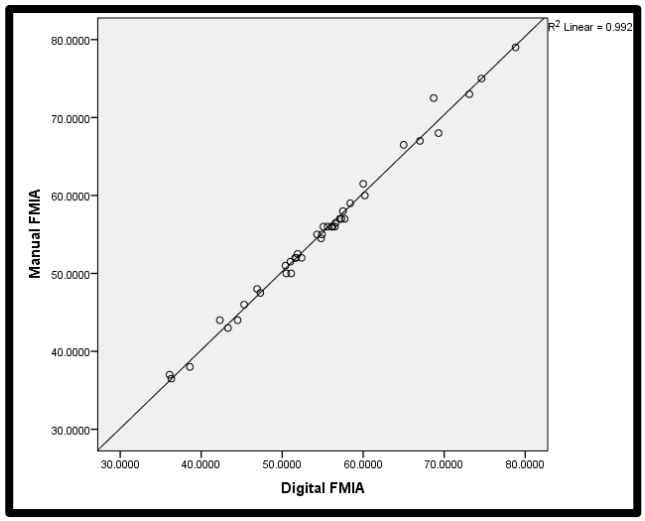
Interpretation

Positive correlation means as one parameter value increases the other also increases. Negative correlation means as one parameter increases the other decreases.

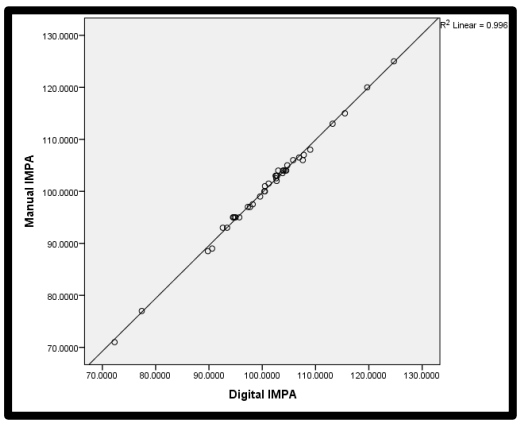
The correlation between the parameters Manual FMIA & Digital FMIA shows a Excellent POSITIVE correlation, and is SIGNIFICANT with a *p* value of <0.001.

The correlation between the parameters Manual IMPA & Digital IMPA shows a Excellent POSITIVE correlation, and is SIGNIFICANT with a *p* value of <0.001.

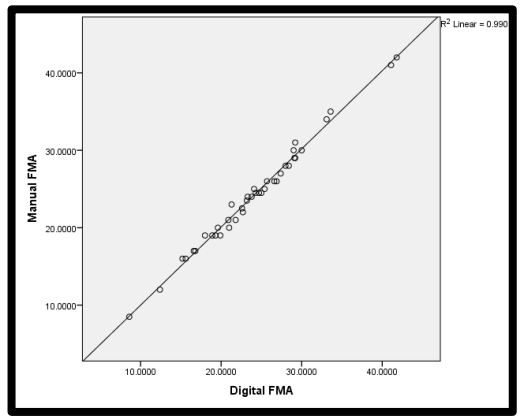
The correlation between the parameters Manual FMA & Digital FMA shows a Excellent POSITIVE correlation, and is SIGNIFICANT with a *p* value of <0.001.



Graph 1: Comparison of values of Manual FMIA and Digital FMIA



Graph 2: Comparison of values of Manual IMPA and Digital IMPA



Graph 3: Comparison of values of Manual FMA and Digital FMA

Discussion

Lateral cephalogram plays an important role in our dental practice; especially in orthodontics cephalometric tracing done by hand previously is being gradually replaced by the digital cephalometric tracing programs in this technological era.Developments in computer technology have lead to increasing use of digital systems both for tracing and analyzing cephalometric films.[9]Use of smartphone by physicians and dentist is increasing rapidly day-by-day. A smart phone has capabilities of a complete operating system and with the use of mobile applications or “apps”, the single-purpose cell phone has become a handheld computer.[10] Numerous smartphone apps that are related to orthodontics have been used by orthodontic clinicians and patients.[11]

Cephalograms are quite difficult to trace, identify, and superimpose and depend on the quality of radiographs and experience of the examiner. In the present study, the hand tracing and digital tracing in android phone are performed by the same examiner to avoid inter- examiner bias. Tracing is done by giving 1 hour gap, and a maximum of five tracing is done per day to avoid eye fatigue, which can cause changes in landmark identification and can compromise the data obtained which can affect the reliability of our study. In hand tracing, landmark identification is quite difficult, especially in identifying Porion (highest point in external auditory meatus). Moreover, the tracing is quite a time-consuming as well as the measurements of cephalometric angles using protractor is also cumbersome. [3,12] Measurements errors associated with the thickness of the pencil line and the perceptive limits of the human eye also contribute to tracing errors.[13]

In the present study, OneCeph cephalometric app was used. This android-based OneCeph app has programs for the most commonly used analysis in cephalometrics such as Downs, Holdway, Jarabak, McNamara, Ricketts, Steiners, Schwarz, Tweed, Wits Appraisal, Beta angle, and Yen angle. This application was developed by Dr. M. Pavan Kumar, Professor in Orthodontics at Kamineni institute of Dental Sciences, Narketpally, India. The potential of a smartphone to simplify a complex, time-consuming diagnostic task such as cephalometric analysis, while simultaneously providing structured reference and e-learning capabilities is a hallmark of this app. The main advantages of digital method are the reduced time and improved data storage, information access. (Chen et al., 2000)

While the use of digital cephalometric tracer requires calibration, improper calibration can affect linear

measurements rather than the angular measurements and is highly sensitive. The study done by Chen et al.[13] on estimating the time required for cephalometric measurement by the traditional method and by computer- assisted digital cephalometric analysis system showed reduced time requirement. Uysal et al. conducted a study on evaluating the speed, repeatability, and reproducibility of digital radiography with manual versus computer- assisted cephalometric analyses found time advantage and interand intra- examiner errors were less in digital analysis.[14]

In a study conducted by Roden-Johnson et al[3] for landmark identification using manual, and Quick Ceph 2000 reported no statistically significant difference between the two which was in accordance with our study. Tsorovas and Karsten conducted a study on the level of measurement and the time demands of hand tracing and five different digital cephalometric programs and found that there is no statistical difference between measurements of the two, but the hand-tracing procedure took a significantly longer time which was in accordance with our study.[15]

Conclusion

In this present study, there is no statistical significant difference is obtained between the values of Tweed analysis done by manual tracing and android based "OneCeph" tracing. The result of this study shows that the digital tracing with the OneCeph android based application had equal accuracy in comparison to the manual tracing. This android based application was relatively faster than the manual method so it can be used instead of traditional method. As the equal reliability of both of these methods, manual method is useful for students or beginners for the knowledge of all the cephalometric points and this application is useful for practitioners as they have the knowledge of all these points but lack of time and so for them this digital method is beneficial as it has ease of storage also.

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Conflicts of interest: There are no conflicts of interest.

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Corresponding Author:
Dr.Nirali Faliya
Department of Orthodontic and Dentofacial Orthopaedics, College of Dental Science and Hospital, Amargadh, Bhavnagar.
Email id: nirali14186@gmail.com