Design and Development of Smart Landline Using 3D Printing Technique

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Article Info

Article history:
Received 25 January 2016
Received in revised form
20 February 2016
Accepted 28 February 2016
Available online 15 June 2016

Keywords
Quality Function Deployment
Ergonomics
3D Printing
Digitizing Reverse Engineering

Abstract

In today's workplace be it office or home, telephones are indispensable entity, since telecommunication is a crucial and growing part of any work. However, using a traditional telephone handset often involves strenuous movement and unnatural postures such as cradling the handset between neck and shoulder, and having to stretch to reach for things. Research in office workplace ergonomics clearly indicates that use of a classic telephone handset by office workers is a major source of work-related neck and back pain.
Spending prolonged periods of time on the telephone can often lead to musculoskeletal disorder like chronic neck, shoulder and upper back pain disorders. While these may seem as unimportant issues but in the long run they can potentially permanent damage to the tendons, muscles, tissues, nerves and supporting structure. Ergonomically poorly designed phone contributes to musculoskeletal symptoms.
The paper at hand focuses on regeneration or modification of hand held equipment (in this case: a landline phone's receiver) using Reverse Engineering. The regeneration is made taking into consideration the Ergonomic factors such as grip comfort and wrist strain due to prolonged usage. The modifications were done so as to incorporate major technological changes, such as converting the obsolete landline phone into a smart landline phone. After making all changes, the new product was manufactured using 3D printing machine ProJet460 installed at JMI, New Delhi. The prototype was then compared to the original model on dimensional accuracy, grip comfort and wrist strain and its advantages, disadvantages and limitations were noted.

1. Introduction

A traditional phone is a telecommunication device which is used to conduct conversation between two people when they are too far apart. But the traditional phone increases the risk of work related musculoskeletal disorder. For example, prolonged period over phone can create tension in neck and shoulder muscle and high discomfort rating. It can cause increased risk of inflammation of joints, inflammation of tendon sheaths, and tendon attachments, Painful muscle sprain, in vertebral disc degeneration.
Ergonomically poorly designed phone also contributes to musculoskeletal symptoms like disproportionate gripping of device, twisting or bending of wrist can cause strain on fingers and wrist. The goal of this project is to redesign the existing telephone system using digitization, reverse engineering and rapid prototyping, focusing to make it more ergonomically suitable for the user and minimize time and resources in its development. In present times product development is a challenging task. Improving the design of the products has to be done continuously for improvement in quality, capacity improvement and better features. This requires faster and frequent changes in the products and the industries need to change itself according to the market. And this change has to be rapid. A short lead-time in product development is strongly demanded to satisfy needs, resulting from the globalization of manufacturing activities and the changes in market requirements (Zhang, 2003).A faster solution to the design problem is modification in the desired direction. A new product can be achieved by slighter or larger modification in the existing products.
To achieve this goal, the landline telephone was first scanned (digitized) using the Steinbichler L3D Scanner with COLIN software present at JMI, New Delhi. The 3D output of the scanned data was exported to rhino software with shape modeling plug in to apply reverse engineering on it. After design evaluation and redesigning the desired parts (receiver), the prototype of the new design was printed using the ProJet 460 Plus 3D printer, also available at JMI. This project focuses on the advantages provided by the modified phone over the traditional one.

1.1. Need For The Work

The need for this work arises due to the following reasons-
- The design of the Traditional Landline has become obsolete for the 21st century users.
- The size of the Traditional Landline makes it unattractive as well as bulky for its usage.
- Mobility of a corded landline is very low.
- Portability in a Traditional landline is absent which makes it as one of the major disadvantage during emergency situations

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- Inbuilt phone-book memory in a Traditional landline is very little.
- The inability of multi task when talking over a corded landline
- Lack of any recording material

The need for this project is to understand the design of traditional landline and redesign it using the scanned data with the help of rhino (shape modelling plug in feature) software and developing it in the form of prototype which is printed using projet 460 plus 3d printing machine.

1.2. Problem Definition and Objectives

In this work we tried to develop an innovative handset using the latest technology platforms. This has been done by introducing a new design concept for a telephone system with hybrid facility i.e. by merging the attributes of a smart phone and a landline telephone. Hence the objective of this project is to create a CAD model of landline phone by using reverse-engineering hardware and software i.e. rhino (shape modeling plug in feature) and modify the same, as per the customer requirements along-with following ergonomic design and ultimately printing for approval.

2. Literature Review

A large work of literature is available in books and journals explaining the process of Reverse Engineering and its applications in the various fields. In this chapter, a review of relevant literature has been made. The survey of literature is based on the applications of Reverse Engineering in mechanical parts, and other related parts. There are many findings which are contributed by numerous researchers and engineers regarding the applications of Reverse Engineering in product development, some of which are as follows:

Lee et al. (1998) proposed a procedure that integrates technique of Reverse Engineering (RE) and Rapid Prototyping (RP) technology. Lin et al. (2005) had presented the measure method the appropriate method to deal with points cloud data and to get the better data points. Reverse engineering software was then used to create the free-form surfaces from the point cloud data.

Mohammad Shadab et al. (2006) presented the applications of the reverse engineering method to model Pillion step holder of Hero Honda CBZ Motor Bike. The CAD model of Pillion step holder had been developed by CATIA V5 using the cloud data.

Li et.al used reverse engineering system for rapid modeling and manufacturing of products with complex surfaces (Li et al., 2002). The system consists of three main components: a three-dimensional optical digitizing system, surface reconstruction software and a rapid prototyping machine in developing products with complex surfaces.

Giovanna Sansoni described a very special and suggestive example of optical three dimensional acquisition, reverse engineering and rapid prototyping of a historic automobile which is Ferrari 250 Mille Miglia, performed primarily using an optical three-dimensional whole-field digitizer based on the projection of incoherent light (OPL- three-dimensional, developed in their laboratory) (Sansoni et.al., 2004).

This project is about design evaluation of a landline phone. One of the research tool applied is Quality Function Deployment. A literature review is made based on the application of QFD in product design as the QFD is the research methodology used in this dissertation.

QFDs early applications focused on industries such as automobiles, software and electronics. The rapid advance of QFD has led to its application in many manufacturing industries. Brown and Harrington (1994); Kim et al., (1997); Nolle et al. (1993); L.-K. Chan et al. (2002) reported QFD applications in telecommunications industry.

Product development and quality management and are achieved in QFD through customer needs analysis which is always the first step of a QFD process and istherefore an important functional domain of QFD. Publications in this field are quite loaded, focusing mainly on the two key aspects of customer needs analysis: collecting/translating customer needs (Bech et. al.1997); (Bergquist et.al.1996), (Temponi et. al. 1999).and and satisfying customer needs (Motwani et al., 1996),(Taylor, 1997; Trappey et al., 1996);(Yang et al., 2000).There are also QFD applications addressing some specific aspects of customer needs analysis, such ascustomer preference (Lai et al., 1998),customer involvement (Huovila and Seren, 1998; Kaulio, 1998; Tottie and Lager, 1995),customer responsiveness (Atkinson, 1990), defining quality requirements (Hauser and Klein, 1988; Hrones et al., 1993; LaSala, 1994), data collection (Casey et al., 1993), and prioritising customer needs (Persson et al., 2000).

Huovila proposed that there are QFD applications attending some specific aspects of customer needs analysis, such as prioritising customer needs (Persson et al., 2000), customer responsiveness (Atkinson 1990), customer preference (Lai et. al.1998), customer services (Graessel and Zeidler, 1993; Riffelmacher, 1991), defining quality requirements (Hauser and Klein, 1988; Hrones et al., 1993; LaSala, 1994) data collection (Casey et. al. 1993), processing client requirements (Kamara and Anumba, 2000; Kamara et al., 1999, 2000), and customer involvement (Huovila and Seren1998); (Kaulio ,1998).

3. Research Tool and Methodology

The research tools applied in this project include – QFD (Quality Function Deployment) and Ergonomics and the project is product design based. This paper employs Quality Function Deployment (QFD) methodology to translate customer needs and requirements into the quality characteristics to improve quality for an existing product to develop a new consumer product. Both of these tools play an important role in the development of this project and they are respectively explained below.

3.1. Quality Function Deployment

As described by Dr. Yoji Akao, who originally developed QFD in Japan in 1966, it is a “method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process”. The main aim to employ QFD is:

- Prioritize spoken and unspoken customer needs and wants.

- Translate these needs into products specifications and technical characteristics.
- Build and deliver a quality product by focusing everything and everybody towards customer satisfaction.

Beginning with the initial matrix, commonly termed the house of quality, the QFD methodology focuses on the most important product or service attributes or qualities. These are composed of customer wows, wants, and musts. Once we have prioritized the attributes and qualities, QFD deploys them to the appropriate organizational function for action. Thus, QFD is the deployment of customer-driven qualities to the responsible functions of an organization.

The house of quality was prepared by taking the voice of the customer in the form of a questionnaire which included the needs and wants of the customer i.e. what attributes and qualities would they prefer the most in a telephone. After listing down these specifications, they were prioritized according to the demand and then infeasible components were neglected. The house of quality was then prepared using voice of the customer, Regulatory Requirements, Customer Importance Ratings , Technical Descriptors - "Voice of the Engineer", Direction of Improvement, Relationship Matrix and Absolute Importance.

QFD is a systematic means of ensuring that customer requirements are accurately translated into relevant technical descriptors throughout each stage of product development. Therefore, meeting or exceeding customer demands means more than just maintaining or improving product performance. It means designing and manufacturing products that delight customers and fulfill their unarticulated desires.

3.2. Ergonomics

Ergonomic entropy (Karwowski et al., 1994) is disorder in system functioning that occurs owing to a lack of compatibility in some or all of the interactions involving the human operator. This incompatibility can occur for a variety of reasons, for example:

- Human requirements for optimal system functioning arenot very well taken care of at the design stage (suitable guide-lines, standards or textbooks are not consulted).
- Inappropriate task design (e.g. new devices introduce unpredicted alterations in the way jobs are carried out and these are unsuited with user habits, knowledge or capacity).
- Lack of prototyping (if the prototype of the product is made then various design changes would have been possible and if any ergonomic factors is missing it can be imparted in the new design)

Various Ergonomic, aesthetic and technical factors were studied which are absent in the Traditional Landline and were later included in the proposed design of the SMART-LANDLINE. Some of the factors include- thickness of receiver, gripping comfort, bulkiness of the phone, restricted mobility, portability, stress on the neck, shoulder and upper body etc.

The concept of both QFD and Ergonomics were not very well taken during the design of Traditional landline phones. If these two concepts are taken into consideration during the design stage, the spoken or unspoken demands of the customer can be met.

4. Ideation

The concept of modification of the existing landline telephone was aimed to overcome the limitations that are inherently found in the traditional phone such as –

- Lack of freedom of movement found in the corded landline
- Inaccessibility of the phone at various ranges
- Cradling the handset between neck and shoulder causes strain
- Reduced human interaction
- Gripping of the receiver causes twisting or bending of wrist which also causes strain on fingers
- Prolonged usage of poorly designed phone creates chronic back, shoulder, upper body disorder etc.

Therefore these limitations were noted and the concept of SMART-LANDLINE was generated to overcome the various problems associated with the traditional-landline. The proposed SMART-LANDLINE will come with an ergonomically designed slim Receiver, A Digital Interface with touch screen and features of a smart-phone, A Beautifully designed elevated Base with a slot for placing the interface. The following features of the SMART-LANDLINE which can be expected from the proposed prototype are-

- Cordless landline, which would offer ultimate freedom of movement to user to get up and walk around in office.
- Digital Display, offers the user increased task-solving capability
- Internet connectivity, which allows the user to be connected 24/7 without having to open his laptop/computer every time
- Digital Notepad, present in the interface throws-out the need of the user to reach for pen and paper immediately as these messages /note can be taken down without changing position or straining to grab the appropriate material
- Digital Interface, which also carries the all the features of a smart-phone such as- Social networking sites, Notepad, Calculator, Message Recorder, Contact storage, Calendar, Internet connectivity etc.
- Speaker Phone, which takes the load off the user compared to picking up and holding a telephone handset and at the same time allowing maximum flexibility while talking to the user.Location of the phone- the phone should be placed close to the main working area which can be easily reached without twist, bend or overly stretch.

5. Steps Involved in Making an Ergonomically Well Designed Telephone

The point cloud data is acquired by scanning the form of x, y and z co-ordinates of the multiple point of the telephone receiver surface. The object (receiver) was then set properly on the rotating table. Multiple scans of the receiver was taken so as to capture the details of its design for the registration purpose and also to avoid the problem of occlusion, accessibility etc. The scanned data from each orientation was aligned and then combined and represented in a common coordinate system. This is known as registration. The telephone receiver was scanned at once for ten different face angles. The scan data was collected with the help scanning software (COLIN 3D) and data was saved as a .STL file format. As the scanned data usually contains some noise some pre-processing operations such as filtering, overlapped point data, etc. were carried out for reducing the scanned data noise. The tools and functions in COLIN create an entirely clean and watertight 360 degree virtual model. The three-dimensional Scanner and/or automatic turntable is operated from the host computer, the data registration is performed automatic, scanned data captured is edited (decimate, fill holes, smooth), scans are merged into a single watertight mesh, and can be exported to a variety of three-dimensional data formats. In this case data is exported in.stl format. COLIN 3D has manual and automatic data registration, smoothing, holes filling, point decimation, data merging, polygon checking (degeneration, intersections), and texture blending and merging. Recreation of a new, ergonomically suitable model of the receiver by scanned data with the help of reverse engineering was done with the help of RHINO software with surface modeling add on.

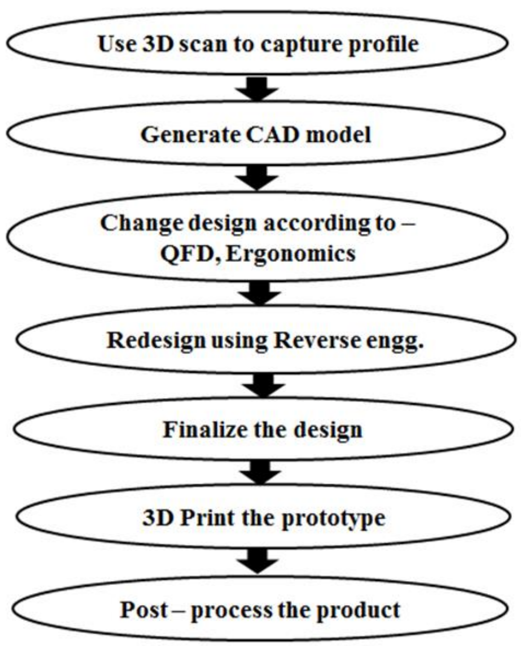

Fig 1- A logical structured approach has been taken to convert the scanned data points into desired features.

RHINO is one of the full featured software for processing three dimensional scanned data. It acts as a bridge between 3D scanners and all other applications, including computer aided manufacturing (CAM), computer aided design (CAD), computer aided engineering (CAE), and others. It converts data from any scanning device which can be either contact or noncontact (in this case blue LED structured light from Steinbichler three dimension scanner) into accurate freeform NURBS surfaces, high quality polygon meshes or geometrically perfect solid models. RHINO offers enhanced quality inspection technology, that allows scanned data to be compared with CAD design data and various dimensions and geometric tolerances can be measured. RHINO has a comprehensive group of tools designed to convert three-dimensional scanned data into high quality, precise and useful data for a wide variety of applications, which ranges from detailed quality inspection reports to reverse engineering parts for CAD/CAM and even to perform surgery planning. There are two sequences of steps that the reverse engineering process might have to go through. The first sequence of steps leads to polygon mesh while other generates NURBS surface. The base of the telephone was made with the help of rhino software to create an improved design of the base.

Hence the process of design evaluation was done in two steps.

- By applying reverse engineering on the existing receiver to make it ergonomically more suitable and
- By applying design changes on the base of the telephone to make it compatible with the receiver.

The final outcome is a SMART LANDLINE that has features of both a smart phone as well as that of a landline.

The final outcome of the telephone was printed with the help of PROJET 460 which works on 3D printing technology. Typically PROJET printers build at a vertical rate of 25mm – 50mm (1” – 2”) per hour. The loose powder supports and surrounds the part in the build chamber. PROJET printer technology does not require the use of attached supports during the printing process, and most of the unused material is reusable. Materials used by PROJET 460 - High Performance Composite.(VisiJet PXL Core with VisiJet PXL Binder).VisiJet PXL Core (formerly zp151) - about 80 to 90% of the material is Calcium Sulphate Hemihydrate. $CaSO_4 \cdot \sim 0.5H_2O$ is more normally known as Plaster of Paris.

5.1. Digitization (Scanning the telephone)

Digitization is defined as the process of creating digital 3D geometry from a physical object. This step is mandatory if we have to alter the existing design of a product. The two major types of digitization today are: contact and non-contact.

The digitization technique and corresponding company considered for this project is Steinbichler L3D scanner with COLIN software. For this project, a Steinbichler Comet L3D blue light scanner was chosen.

The first step in creating a CAD model for an existing part is part digitization. Digitization is a process of acquiring point coordinates from part surfaces.The process of digitization starts with Data acquisition. Data acquisition systems are constrained by physical considerations to acquire data from a limited region of an objects surface. Therefore, multiple scans of the surface should be taken to completely measure an object as in our case – a Telephone. In this paper, we use non-contact three dimensional Digitizer STEINBICHLER COMET L3D which uses structured light technique. The structured lighting system that is used for this project generates a different set of images when performing the image acquisition process. In structured-light techniques (Park et al. 2001; Pages et al. 2003) a light pattern is projected at an angle which is known onto the surface of interest and an image of the resulting pattern, reflected by the surface, is captured. The image is then analyzed to calculate the coordinates of the data point on the surface.

Digitization is done in various steps i.e. Single Views and Data Segmentation, Pre-processing the range images, Multiple View Integration and Registration and Post-processing Registered Images.

Pre-processing the range images is the step proceeding data collection. Pre-processing is more commonly termed as cleaning of the collected data. Pre-processing is applied to the single views individual before they are integrated and registered together. Pre-processing also includes reducing erroneous data, filtering noise and filling holes that may have occurred as a result of occlusions.

It is necessary to combine multiple views taken with the object placed in different orientations in front of the scanner because it can capture data from a limited region of the object's surface. The final aim of collecting multiple views of range images is to register the images. COLIN 3D software is used to match similar features and points on the different surfaces scanned and after the points have been selected for matching, three or more points are matched based on similar corresponding features and feature location. This is commonly referred to as feature matching or extraction.

Post-processing of range images includes surface smoothing and multiple view registration. COLIN is used to create water tight, clean 360 degree virtual model. The three-dimensional Digitizer (steinbichler comet L3D) is operated from the host computer, perform automatic data registration, edit captured scan data (decimate, fill holes, smooth), merge scans into a single "watertight" mesh, and export to various three-dimensional data formats.

The digitization process resulted in a three-dimensional point cloud data points also known as range image.

5.2. Reverse Engineering

Abella et al. (1994) described RE as, "the basic concept of producing a part based on an original or physical model without the use of an engineering drawing". Reverse engineering is the process of duplicating an existing part, subassembly, or product, without drawings, documentation, or a computer model. It recreates or clones an existing part by acquiring the surface data of an existing part using scanning or measuring device (Lee et.al. 2000).Reverse engineering has been rather common and essential especially when it comes to a situation that the original product design documentation has been obsolete or never existed, some bad features of a product need to be eliminated, analyzing the good and bad features of competitors' products, exploring new avenues to improve product performance and features and so forth (Raja et al., 2008).

5.2.1. Reverse Engineering Phases and operations

1) Points and Images Phase and operations;

In the points and images phase, scan data are registered, prepared, and optimized for constructing 3-D polygon models.

A) Data Registration

When we use different scan setups, the point cloud from one series of scans is not oriented accurately with respect to the point cloud from another series. Data registration is needed to combine, align, or merge these point clouds so as to arrange all point clouds in the series in their proper orientation relative to one another in a common coordinate system.

B) Data Optimization

•Noise and Point Redundancy Reduction-During the point cloud registration; the aligned scan data normally contains overlapping points. Noise reduction tools are used for both manually and automatically removing the noise in scanned data.

- Sampling Points- The sampling is used to minimize the number of points in the point cloud data and to make the data well-structured so that it is easier to handle.
- Identifying Primitives- Identifying primitives such as cylinders, planes, and spheres is important in the Reverse Engineering process, The primitive creation operation inserts mathematically perfect primitives within a model.

2) Polygon Phase

Polygon models are constructed in this phase and then they are manipulated and controlled to meet the requirements of the applications.

A) Optimizing Polygon Models-Important operations for optimizing polygon models are polygon mesh decimation, noise reduction and cleaning, polygon mesh refinement, and abnormal face cleaning.

- Noise Reduction and Cleaning- Here noise introduced into polygon models is filtered and removed. Usually, different levels of noise reduction are selected so that the mesh quality is controlled.
- Abnormal Face Cleaning- This operation cleans up abnormal faces in polygon models. Typical abnormal faces in the polygon phase include the following: Redundant faces: This occurs when a number of faces and edges share the same vertex and Crossing faces: This occurs when edges that share a vertex intersect with one another.
- Polygon Mesh Refinement and Decimation-The surface of a polygon model is improved in Polygon mesh refinement process by adding new vertices and adjusting the coordinates of existing vertices, which results in a greater number of triangles in the selected region and a smoother surface whereas polygon mesh decimation reduces the number of triangles without compromising surface integrity or detail.

B) Editing and Controlling Polygon Models

- Filling Holes - This operation is used to fill gaps that were introduced during scanning or because of errors in converting point clouds into polygon models. A polygonal structure is used to fill the hole.
- De-featuring - The operation is useful for refining and smoothing the selected region. This operation helps in refitting selected regions with a new triangulated polygon surface using a curvature-based method and the features in the selected region are deleted.
- Edge Detection and Sharpening Control - Scanning devices are usually unable to effectively capture sharp features. This operation reproduces an edge by

redefining it mathematically and then extending the polygon model to that newly defined sharp edge.

- Primitives Fitting- The primitives fitting operation fits selected regions to primitives such as planes, spheres and cylinders.
- Polygon Editing and Re-meshing- Polygon editing and re-meshing gives precise control over the polygonal mesh structure down to the triangle level.
- Boundary Control and Editing - Boundary control and editing are important steps when working with open polygon surfaces. This operation is used to repair the boundary edges of a model. It also provides the ability to mark edges of triangles to create boundaries, which are a series of triangle edges.
- Basic Polygon Operations - The basic polygon operations are very familiar in CAD modeling packages. They include Boolean, mirror, rotate and move, thicken, trim, shell, offset, and datum control.

3) Curve Phase

The NURBS surface is defined by a network of curves. Therefore, when applying the “Manual Creation of NURBS from Basic CAD Entities” approach, point clouds and polygon models are normally used for creating curves, especially for parts with free-form surfaces.

The most useful curve modification options are as follows:

- Curve Re-parameterization: redistributing control points along the curve or changing the number of control points
- Curve Degree Conversion: Changing the degree of a curve with a stated tolerance.
- Cleaning and Curve Smoothing: Smoothing a curve, cleaning, and removing unnecessary control points.
- Control Point Editing: Modifying the control points manually. The control points are moved to the specified positions to change the shape of a curve as desired.
- Point Generation: Creating a specified number of points from a curve with random or uniform distribution.
- Curve Redirection, Transition, and Extension: Changing the direction of the curves, stitching two curves together to make a new one, and extending a curve to a point or distance with tangent or curvature continuity.

4) NURBS Surface Phase

NURBS surfaces can be constructed by using polygon meshes for surface fitting and also based on the CAD entities extracted from the curve phase. NURBS are an accurate way to define free-form curves and surfaces.

6. Rapid Prototyping

For the purposes of this project, rapid prototyping (RP) refers to the automated generation of a physical object from a computer model. Most rapid prototyping methods need a polygonal representation of part geometry such as STL, which is a common file export option for most CAD packages. Software is then used to slice the parts into thin cross-sections, and the part is built up layer by layer.

A ProJet 460Plus3D printer was used in this project. The ProJet 460Plus 3D printer is based on 3D printing technology invented at the Massachusetts Institute of Technology, patented by MIT. 3DP technology creates 3D physical prototypes by solidifying layers of deposited powder using a liquid binder.

6.1. Limitations

- The proposed design of the landline may be ergonomically designed which may enhance the design work process in future but it comes with a baggage of high cost associated with providing technologically enhanced features.
- The prototype cannot be printed with any other material other than visijet PXL. It would be a lot more appropriate to present the prototype made up of the same material as that of the original product for better comparison.

Fig 2-Scanning the receiver from different views for the registration by using structured light

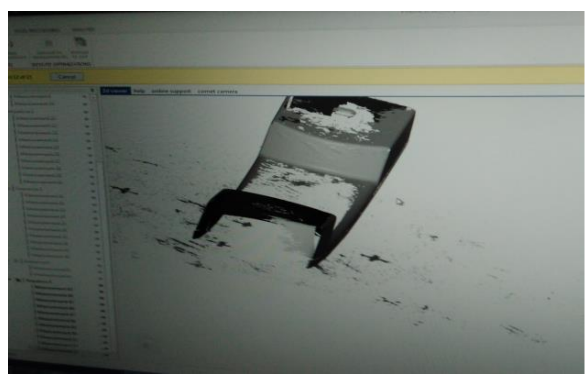

Fig 3 - Point cloud image of the receiver

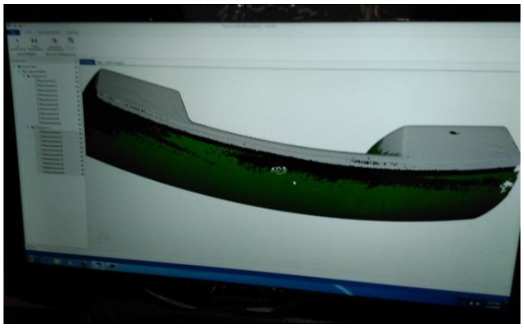

Fig 4 - Scanned image after alignment before alignment

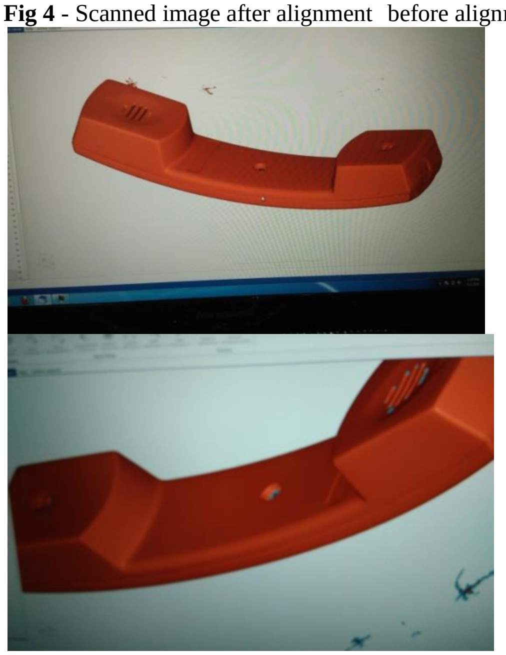

Fig 5 - Scanned image of the receiver after post processing

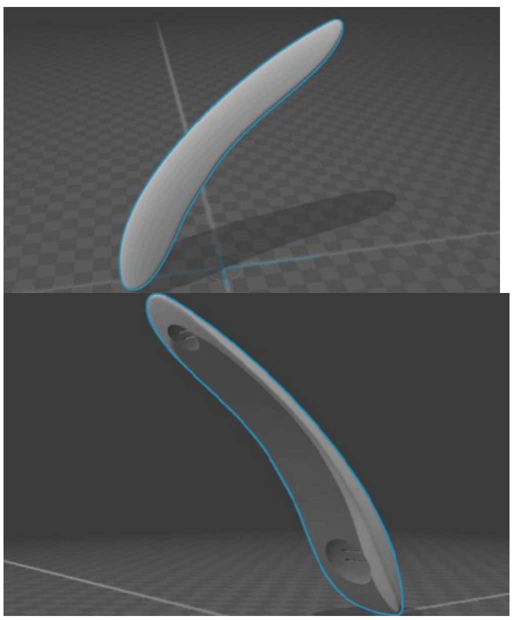

Fig 6 -Different views of ergonomically designed receiver

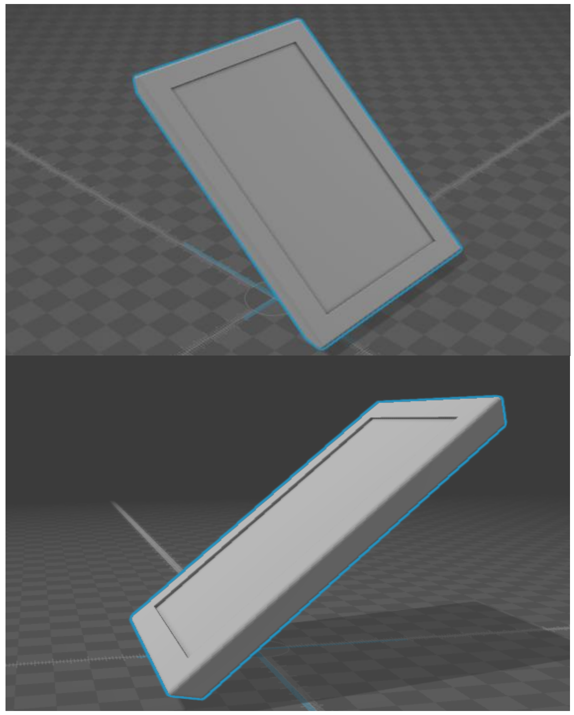

Fig 7 - Different views of digital interface

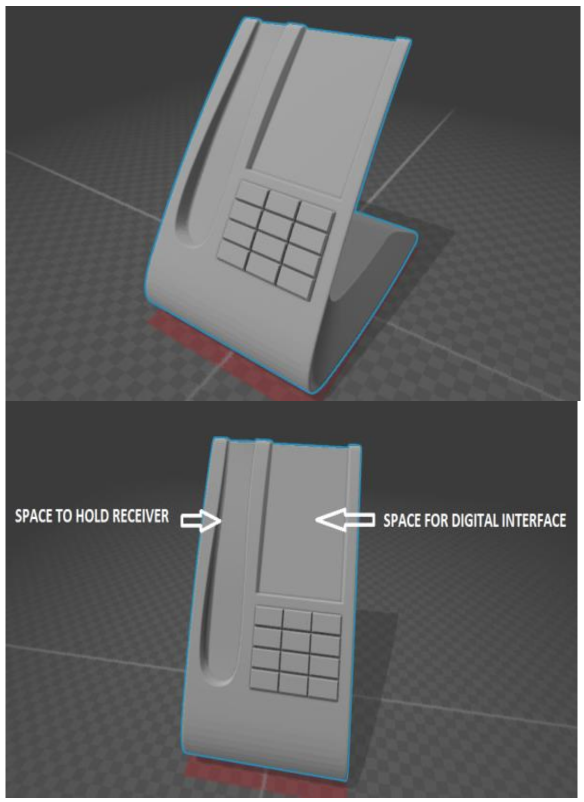

Fig 8 - Different views of the base of landline telephone

Fig 9 - Prototype of the base and receiver before cleaning and post-processing

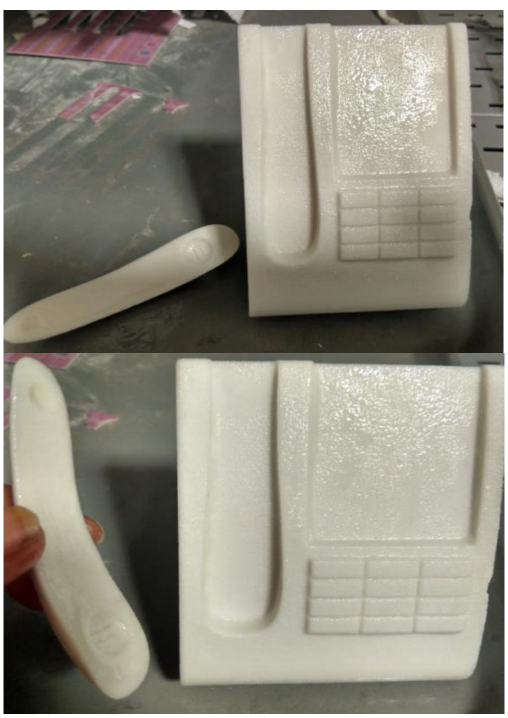

Fig 10 -Prototype after post processing with Color Bond

Fig 11 - Final assembly of the prototype

7. Conclusions and Recommendations for Future Scope

- Various other ergonomically factors can be taken into consideration during the design stage
- New applications can be included in the proposed design; it could be further designed for the surveillance purpose. A concept similar to CCTV can be installed in it which can reduce the crime if the phone is installed at a public booth.
- Work can be done to instill a digital interface app which can dial an emergency no. or police no. within no time which will further add to home security.

This paper, proposed the concept of SMART-LANDLINE, a modification in Traditional Landline Phone combining the features of a smart phone as well as a telephone so as to preserve the concept of landline phones which is currently facing a major decline.

The design proposed by me includes changing the design of both the receiver as well as the base of the telephone to suit the needs of the user. Since the traditional landline has become obsolete according to the needs of the current and future generation, I studied various aspects of the telephone that has made it unsuitable for further use. I found that one of the major factor that has made landline unsuitable is its bulky size and shape and therefore I studied the associated ergonomics and came up with a new slimmer and ergonomically changed design of the receiver and also its base.

The design of both the components of the telephone were changed in the software Rhino with shape modeling plug-in, which is an add on feature of Rhino.

Comparing the Traditional landline with the modified Landline, I can successfully conclude that the modified design is a much better version of the landline not only aesthetically but also technically. The SMART-LANDLINE includes a slim ergonomically designed receiver which not only reduces the stress on the wrist but also increases the gripping duration if the user is over the phone for a longer time. The base of the phone has been tilted to such an angle that it will not only reduce the strain on the neck during bending but will also fall in the line of sight of the user. The base of the telephone is also provided with digital interface which facilitated the user to carry out such functions that were not possible with the traditional landline. These functions are similar to the functions of a smart phone such as- notepad, voice recorder, internet connectivity, calculator etc.

The images of original scanned data and ergonomically redesigned images of the landline phone are shown below:

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