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Design and Fabrication of Helmet using 3D Printing Technology by Considering Various Parameters

M.Shanmugam[1], V.Siranjeevi[2], S.Susindhar[2], E.Varun Kumar[2], K.Vishnu[2].

[1]Assistant Professor, [2]UG Students,
Department of Mechanical Engineering, Nandha Engineering College, Erode-52,
Tamil Nadu, India.
[1] shanmugam@gmail.com, [2] siranjeevi836@gmail.com, [2]susindhar.chml@gmail.com,
[2]bebest.404@gmail.com, [2]vishnume96@gmail.com

Abstract:3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping. This is a mechanized method whereby 3D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object. The 3D printing concept of custom manufacturing is exciting to nearly everyone. This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate model parts. Now, you can create a complete model in a single process using 3D printing. Subsequently, the aim of this study was to assess the two wheeler driver safety helmet and to aid redesigning the improvements on the safety helmet based on several designing techniques of industrial engineering. Further designing of the improvements made on the safety helmet was carried out using the catia and solid works where else a 3D printer was used to print out the helmet.

Keywords: 3Dprinting technology; safety helmet; heat rejection using fin technology

I. INTRODUCTION

3D Printing is the growing technology in nowadays. In that technology there are so many types such as SLS, FDM, Inkjet or Polyjet. Here we used polyjet process for making a 3D printed material-Helmet. PolyJet is a powerful 3D printing technology that produces smooth, accurate parts, prototypes and tooling. With microscopic 1 resolution and accuracy down to 0.1 mm, we can produce thin walls and complex geometries using the widest range of mate available with any technology. 1. Pre-processing 2. Production 3. Support removal these are the steps in polyjet process. By Using these techniques we are going to do product on cooling system helmet. A helmet is a form of protective gear worn to protect the head from injuries. In this fast developing era, it is always unpredictable when, where, to whom and how accidents might occur but the consequence of it might cause injuries of various severity or even death. According to the data collected by the public. In addition, a research was carried out to study the number of visits into the emergency departments by different age group to reflect the age group that are prone to injuries in India. In this fast developing era, it is always unpredictable when, where, to whom and how accidents might occur but the consequence of it might cause injuries of various severity or even death. Design for the helmet is completed which reduce the temperature inside the helmet at the time of wearing. In order to reduce the temperature inside the helmet we had choose pin fin mode of heat transfer technology. By the use of thermoplastic material we can reduce the weight of the helmet.

II. RELATEDWORK

3D printing is a popular additive manufacturing technique to manufacture a product according to its specifications by adding material layer by layer and it can fabricate more complex design as well (Bowden, 2014). The 3D printer applications have a very wide range of scope and one of its applications is in the modelling skill enhancement where students with the 3D printer will be able to use the software to print out the product and recognize their errors easily. Another application of this 3D printer is in the field of mechanics which will be very useful to print many types of screws, gears and other small gadgets or machines (Moorefield-Lang, 2012). In 1980s, additive manufacturing were used directly from a digital CAD to produce 3D objects and the objects were made of polymers only. Besides that, additive manufacturing are also used to create arbitrarily geometric objects. It is also known as a rapid prototyping due to its usage of visualizing models and produce prototypes (AlaaElwany, 2014). Industrial engineers have the skills to monitor a process and optimize the time and cost of the product which helps in improving the part

being produced. This 3D application for creating physical models of paediatric orthopaedic disorders has a limitation where it is only accessible in a few revolutionary machine shops and the printers are expensive. A 3D print scale provides a tactile and visual experience on how the human's visua-haptic inputs leads to less ambiguity in the understanding of the shape of an object (Cooke, 2007). In conclusion, 3D applications do have advantages towards the patients which are over the conventional volume rendering on a 3D workstation for surgical planning and patient education. Next, mechanism that involved in laser additive manufacturing are metal and fabricated polymer. The laser additive manufacturing (LAM) is becoming very popular among the jewellery and dental implants companies who are competing among themselves to enhance the functional coherence of more sophisticated laser additive manufacturing components (Overton, 2013). The Global Industry Analyst (GIA; San Jose, CA) assumes that 3D printing is one of the hottest manufacturing gravitate that is hopeful to reach at $4.5 billion by 2018.In past few years only chin guard and some of the part was printed using 3d printer now a day's whole helmet was printed using 3d printer. This paper deals with reducing the helmet heat with use of fin pint technology which is one of the heat transfer method used in two wheelers.3d printing method reduces the manufacturing time and cost. Then accuracy are also more compared to another rapid prototyping technology.

III.METHODOLOGY

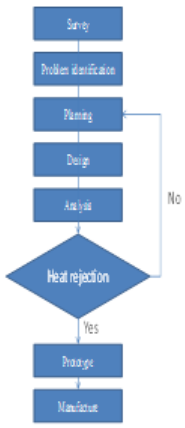


Fig. 3.1 methodology

WORKINGDESCRIPTION

A. SURVEY

In above mentioned methodology first step describes a survey which was taken from several cities with our project members

Then Project survey format was mentioned below:


SURVEY FORMAT

NANDHA ENGINEERING COLLEGE, ERODE – 638 052
DEPARTMENT OF MECHANICAL ENGINEERING
and
Advanced Integrated Manufacturing and Management Research Group (AIMMRG)
Coimbatore Institute of Technology, Coimbatore – 641 014

BIKE HELMET OUTLOOK SURVEY FOR PROJECT WORK

Name :	
Address :	
Gender :	☐ Male / ☐ Female / ☐ Transgender
Age :	☐ 18 to 29 ☐ 30 to 40 ☐ 41 to 50 ☐ 50 and above
Do You wear Helmet :	☐ Yes / ☐ No
If No, why	
Do you think it's safe :	☐ Yes / ☐ No
Do you have any health problem, while wearing Helmet :	☐ Yes / ☐ No
Please Answer the following Questions related to health problem, while wearing Helmet	
Do you have Neck pain	☐ Yes / ☐ No
Do you have Hair loss	☐ Yes / ☐ No
Do you have Head ache	☐ Yes / ☐ No
Do you have Spinal injury	☐ Yes / ☐ No
Do you have Vision problem	☐ Yes / ☐ No
Do you have Audible problem	☐ Yes / ☐ No
Any other suggestions,	

Survey taken by:

Fig. 3.2 survey format

Then public has given some suggestion related to our project.

As per the suggestion of public survey some cons was finded With the help of this cons our project moves to next step.

PROBLEM IDENTIFICATION

As per the survey taken from the public some of the problem has been identified. They are:

- head ache
- neck pain
- hair loss
- sweating

The demerits given by the people are in Percentage:

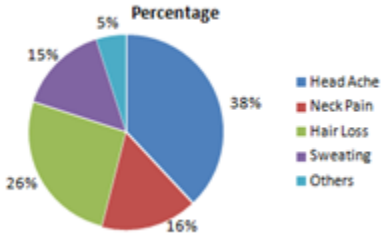
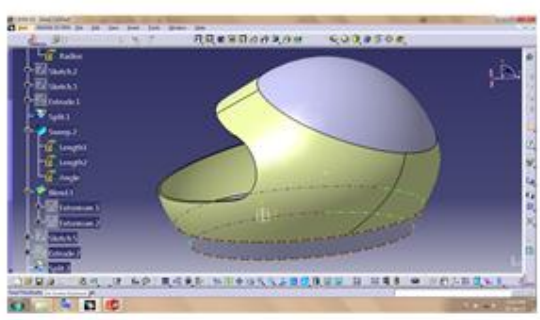


Fig. 3.3 percentage calculation

B.PLANNING

As per the survey taken from several cities some of the demerits was found in present helmet. So in order to eradicate that kind of demerits some steps had been taken to overcome that problem. From our survey result head ache, neck pain, sweating, hair loss are the major problem occurred while wearing helmet .So we has planned to use pin fin technology to reduce heat which was present inside the helmet.

C.DESIGN



FFig. 3.3 helmet design

The figure 3.3 represents the present helmet design which is drawn by CATIA software which is made of polystyrene material.

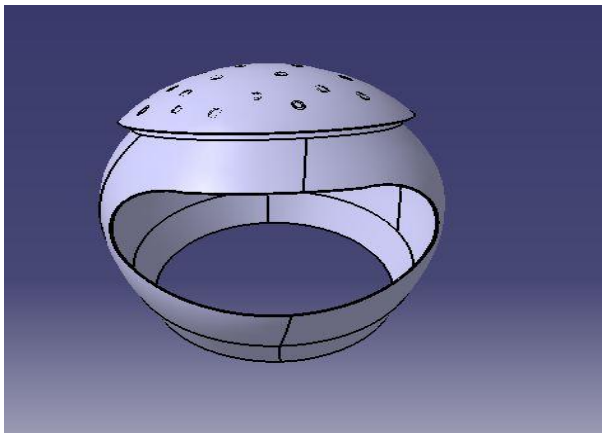


Fig. 3.4modified design

The figure 3.4 represents our project design fin is placed in between the fin base and fin wall. This helmet made up of ABS material and printed by 3D printer.

D.ANALYSIS

In our project analysis was made between the present helmet design and our project design between this two helmet design velocity of air and heat transfer was analysed.

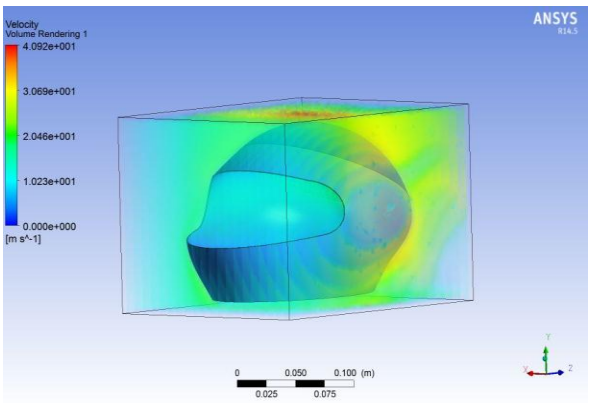


Fig. 3.5 velocity analysis

The figure 3.5 represents velocity of air analysis for present helmet design the inlet air speed is 40km/hr(or)11.11m/s.

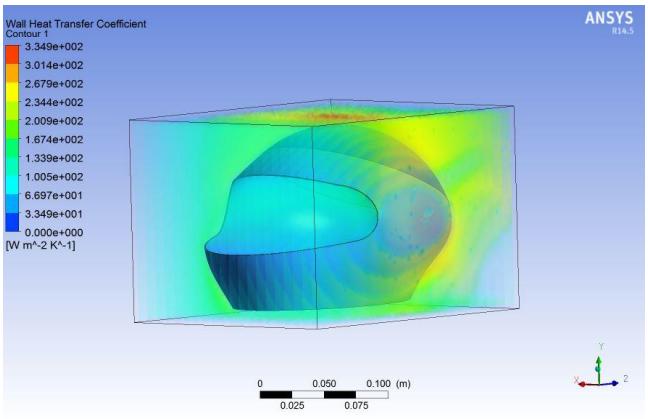


Fig. 3.6 heat transfer analysis

Then figure 3.6 represents heat transfer analysis for present helmet .In this helmet design inlet temperature was 38^0c, for this helmet maximum heat transfer coefficient was 3.349e+002.

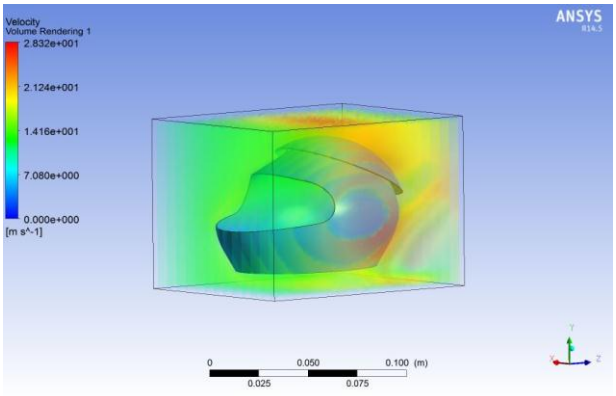


Fig. 3.7 air flow analysis

This figure 3.7 represents velocity of air analysis for our modified project design.

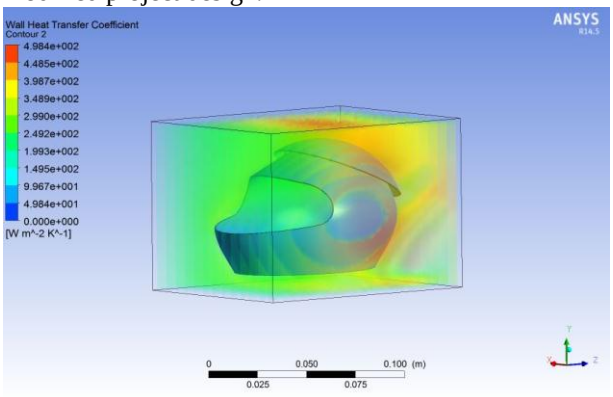


Fig. 3.8 heat transfer coefficient analysis

This figure 3.8 represents analysis of heat transfer coefficient for Our project design. In our analysis both the helmet design are taken in a enclose box the inlet air comes infront of the helmet at 40km/hr .Inside helmet temperature was 38^0c and

fin temperature was 60^0c.Helmet design geometry was palced in a ansys software. Heat transfer was analysed in ansys workbench 14.5 and air flow was analysed in ansys fluent analysis(CFD).In this analysis tectahedral mesh is used to mesh the object. Due to curved surface tetrahedral mesh is used.

Mesh Report

Mesh information for FFF

Domain	Nodes	Elements
partbody	37661	136526
Solid	150388	782723
All Domains	188049	9192

E.HEAT REJECTION

From our analysis report velocity of air is more in present Hemet design compared to our project design .Then from another analysis report heat transfer coefficient is less in present helmet design compared to our project design. So finally heat rejection is possible in our project design .So then our project next move to the porotypestage. If heat is not possible in our design means it will again move to the previous stage. With our final analysis report we had proved our design had rejected the heat.

F.PROTOTYPE

The prototype is made with rapid prototyping technology our project design is converted into stl format and the design is inserted into the 3d printer .The prototype is made by layer by layer method. Plastic materials are in powder form.

G.MANUFACTURE

Manufacturing is done by 3D printing technology our project design is 63.5mm height and 98.5mm width.

IV.**SUMMARY**

The 3Dprinting helmet acts as a basic platform for the coming Generation of more aiding devices to help the visually impaired to be safer. It is effective and afford. It leads to good results in providing light weight and safety helmet for two wheeler drivers. This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate model parts.

IV.**REFERENCES**

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