Imagine Cup Junior Submission

Submitting institution/school: On My Own Technology

Student Team Name: Team G-Force

Project title: Creating Haptic 4D model along with Machine Learning analysis by developing a

Non-Invasive pressure mapping method to screen Genital Skin Cancer

Number of team members: 2

Age range of team members: 17 years

AI for Good Initiative: Health/Humanitarian Action

(Select one from: Accessibility/Earth/Cultural Heritage/Humanitarian Action)

The Problem

Cancer is Curable, but only when it is detected early.

Conventional Method to identify skin cancer is Biopsy.

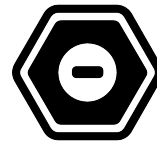Situations become worse when considering Genital Skin Cancer

Expensive and Time Consuming
On average, biopsies in the genital region cost around $1500

Painful and Invasive
May Lead to numbness, pain and infection in genital area.

Invasion of Privacy
Patients have to experience an invasion of their privacy every time

Restrictions and Insecurities
These are barriers to early detection since users do not reveal the lesion early.
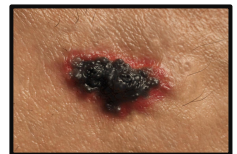
Research and Innovation Goals

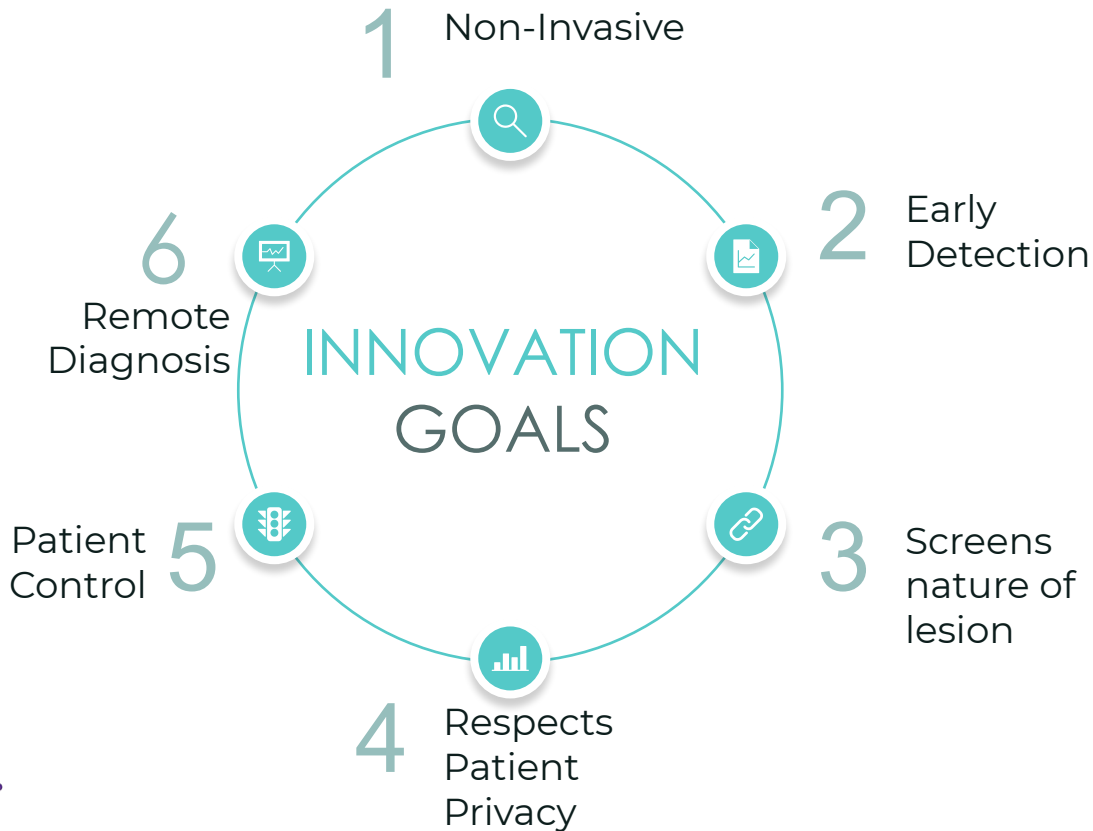Recovery Chances per stage of skin cancer discovered:

Stage 0 & 1 — ~90%

Stage 2 — ~60%

Stage 3 & 4 — ~15%

INNOVATION GOALS

1 Non-Invasive

2 Early Detection

3 Screens nature of lesion

4 Respects Patient Privacy

5 Patient Control

6 Remote Diagnosis

Concept - General Procedure

83%

Accuracy of DCNN

80% Train data

20% test data

We have trained our Deep Convolutional Neural Network with 5000 images

TRAINED DCNN MODEL
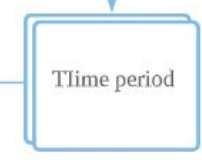
PRESSURE MAP KIT

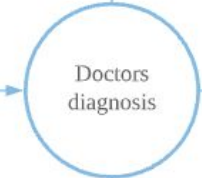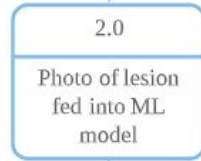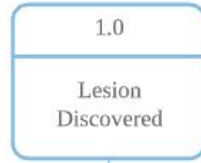The pressure map kit is a non-invasive method to map pressure points across the lesion, using Dilatant Non-newtonian fluid with a small voltage across it, in a small standard device.

Flowchart

1.0
Lesion Discovered

2.0
Photo of lesion fed into ML model

Results sent to doctor for analysis

Biopsy

Doctors diagnosis

Further Analysis required

Use of pressure mapping

Genereate supports and .STL file

Files convoluted and sent to doctor

3D Printed using flexible filament and analysed by doctor

Doctor Diagnosis

Non-cancerous

Lesion growth comparison and re-analysed

TIime period

Concept - Pressure Mapping Method
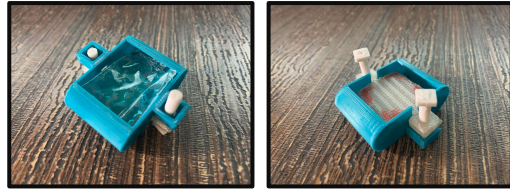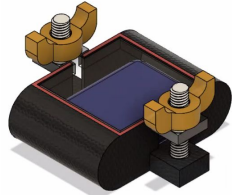
Our Real Life Prototype

Pressure Mapping Kit

This 30mm device will be used for the screening method. It has a transparent screen with a grid guiding the user while taking pictures of the lesion. Our key and screw system will also help provide ideal pressure and also helps to insert DNNF packs

01

FLEXIBLE CASE

Flexible case to map accurately on curvy genital regions

02

Transparent Screen

The plastic screen is transparent allowing the lesion to be seen through the kit

03

Guidelines On Screen

The red lines show the grid under which the lesion has to be placed

04

Insertable DNNF Pack

DNNF can be inserted in the kit when needed also making our case reusable

05

Key and Screw

Allow in precise density measures and help change the DNNF pack

Ethics

Fair

RIDGE provides everyone an equal chance to screen their genital skin lesions by being economically efficient, remote and easy to use.

Inclusive

RIDGE creates awareness about suspicious skin lesions, promoting self care and regular check in the genital region.

Reliable

Screening analysis sent to doctors, helping them diagnose skin cancer as reliably as they can remotely, by providing visual and tactile data.

Safe

Completely safe since all screening processes and pressure mapping is done by users with medical grade equipment.

Transparent

Ridge is transparent since all data which is sent between ridge and the doctor is taken and shown to the user.

Privacy

RIDGE's main goal is to increase user privacy by conducting remote screening at home, reducing invasion of privacy and increasing early detection

Solving The Problem

Currently Available	Improvement due to RIDGE
1. Biopsy taken on discovering a lesion	1. Helps to make a decision on biopsy
1. **Invasive, costly, time consuming, and can lead to severe pain and infection**	1. Non-invasive, cost-efficient, can be done from home
1. More than **81%** people are not comfortable consulting	1. Control of the screening process, doctor gets tactile feedback
1. Cancer **spreads** past treating stage	1. Lesions being discovered and diagnosed early, preventing from spreading

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Impact and Vision

Accuracy of PM Kit to be clinically measured

Can be used to virtually assess various skin disorders

New dataset with 24,000 images and supporting clinical data to be used for better results.

PM Kit can be used by women to self assess themselves for breast cancer

RIDGE

Deploy machine learning model with doctors to train for 2 years to detect anomalies in unusual cases

DCNN model can be trained with a dataset for other skin disorders

Invited to work at Tata Memorial Hospital (india's Largest Cancer institution).

83% accurate deep learning model report with precise tactile feedback

Aiming to achieve accuracy of over 95-98% for accurate screening

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Use of Artificial intelligence

```
"clinical": {
  "age_approx": 25,
  "anatom_site_general": "posterior torso",
  "benign_malignant": "benign",
  "diagnosis": "nevus",
  "diagnosis_confirm_type": null,
  "melanocytic": true,
  "sex": "female"
}
```

1

2

3

8

9

10

11

12

4

5

6

7

```
Confusion Matrix
[[48 36 25 37 54]
 [49 35 27 31 58]
 [49 37 21 28 65]
 [57 27 18 33 65]
 [51 36 19 41 53]]
```

```
classification Report
              precision    recall  f1-score   support

          AK       0.19      0.24      0.21       200
         BCC       0.20      0.17      0.19       200
          IC       0.19      0.10      0.14       200
         Mel       0.19      0.17      0.18       200
         SCC       0.18      0.27      0.21       200

    accuracy                           0.19      1000
   macro avg       0.19      0.19      0.19      1000
weighted avg       0.19      0.19      0.19      1000
```

Optimum Hyper-parameters

Through training and testing we realised 3 hidden layers do not overfit the model, but yield 83% accuracy.

Low Training Time

We used only 5000 images, 4:1 ratio for train, test with high epochs and low batch rate for low training time.

New Data Set

The ISIC dataset has provided us with 24000 images, with clinical information on each image. Will allow us to factor in patient details and increase accuracy.
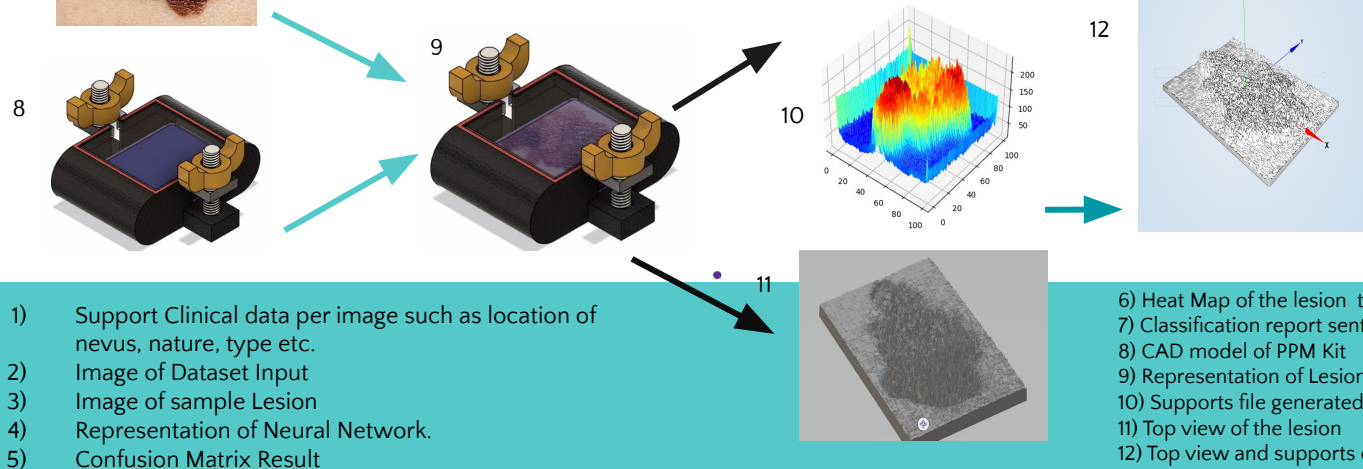
1) Support Clinical data per image such as location of nevus, nature, type etc.
2) Image of Dataset Input
3) Image of sample Lesion
4) Representation of Neural Network.
5) Confusion Matrix Result

6) Heat Map of the lesion to provide texture analysis
7) Classification report sent to detector
8) CAD model of PPM Kit
9) Representation of Lesion Imprint on Gel pack seen from top
10) Supports file generated using AI algorithms
11) Top view of the lesion
12) Top view and supports combined to give 3D printable flexible file

References

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https://moffitt.org/cancers/vulvar-cancer/
https://www.cancer.net/cancer-types/vulvar-cancer/introduction#:~:text=The%20most%20common%20is%20squamous,are%20found%20on%20the%20labia.
(arxiv.org)

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Thank you!

Microsoft