Empowering Hair Health with Intelligent Hair Disease Detection System.

TMP 23-154

Project Proposal Report

Alahakoon D.Y.R

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B.Sc. (Hons) Degree in Information Technology

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Supervisor: Ms. Lokesha

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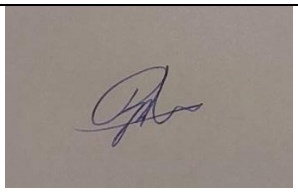
Declaration of the candidate & Supervisor

To the best of our knowledge and belief, this proposal does not contain any previously published or written by another person material, except where the acknowledgement is made in the text. We declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or Institute of higher learning.

Name	IT Number	Signature
Alahakoon D.Y.R	IT20129026	

The proposal report should be certified by the appropriate supervisor(s) with the following statement.

Under my supervision, the aforementioned candidates are conducting research for their undergraduate dissertation.

_____ _____

Supervisor Signature Date

Acknowledgment

I would like to express my sincere gratitude to my supervisor, Ms. Lokeesha, for her guidance and support throughout the research process. Her expertise and insightful feedback were invaluable in shaping the direction of the project. I am grateful for her patience and dedication in helping me navigate through the challenges of the research process. Additionally, I would like to thank the participants who volunteered their time to take part in the research study. Without their willingness to participate, this project would not have been possible. Moreover, I would like to acknowledge the support of the staff of the institutions that provided access to the necessary resources for this project. Lastly, I am grateful to my family and friends for their unwavering support and encouragement throughout this project.

Abstract

This research project proposes an innovative approach to improving hair health through the development of an intelligent hair disease detection system. The system leverages advanced machine learning techniques and image processing algorithms to accurately detect and diagnose various hair diseases, such as alopecia, dandruff, and psoriasis. The proposed system aims to empower individuals to take proactive measures towards maintaining optimal hair health by detecting potential hair diseases at an early stage. The research project involves the design and development of the intelligent hair disease detection system, as well as conducting extensive testing to evaluate its performance and effectiveness. The ultimate goal of this project is to create a valuable tool for both individuals and hair care professionals, enabling them to improve hair health and quality of life.

The proposed intelligent hair disease detection system incorporates a real-time monitoring component to provide users with up-to-date information on their hair health status. This feature allows individuals to monitor any changes in their hair health on a continuous basis and take necessary actions to prevent or mitigate any potential hair diseases. The real-time monitoring component of the system also enables hair care professionals to remotely monitor the hair health of their clients, providing them with valuable insights and recommendations for hair care. Overall, the real-time monitoring feature enhances the functionality and usefulness of the proposed intelligent hair disease detection system, making it a valuable tool for improving hair health.

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List of abbreviations

Abbreviation	Description
ML	Machine Learning
IMP	Image Processing
NN	Neural Network
DL	Deep Learning
API	Application Programming Interface
IOT	Internet of Things
OCR	Optical Character Recognition

1. Introduction

1.1 Background

People of all ages and genders can develop hair illnesses, which can cause a number of hairrelated issues like hair loss, dandruff, and inflamed scalps. These hair conditions can have a negative effect on a person's quality of life, causing discomfort, anxiety, and social stigma. To successfully stop the progression of hair diseases and manage their symptoms, early detection and diagnosis are essential. But many people are unable to access the current methods for diagnosing hair diseases because they are frequently time-consuming, costly, and demand specialized knowledge.

Recent developments in machine learning and image processing methods have opened up new possibilities for the creation of intelligent hair disease detection systems that can effectively and non-invasively identify a variety of hair diseases. These systems examine images of hair to find any irregularities in the condition of the hair and scalp using computer vision algorithms. However, the majority of currently available systems for detecting hair diseases lack real-time monitoring capabilities, which limits their utility in providing ongoing updates on the condition of the hair.

In order to enable people to take proactive steps to keep optimal hair health, this study project suggests the creation of an intelligent hair disease detection system with a real-time monitoring component. The suggested system correctly detects and diagnoses a variety of hair diseases, including alopecia, dandruff, and psoriasis, by utilizing cutting-edge machine learning techniques and image processing algorithms. People can continuously monitor changes in the health of their hair thanks to the system's real-time monitoring feature, which enables them to take the required precautions to ward off or at least lessen any potential hair diseases. The system's realtime monitoring feature also enables hair care professionals to remotely monitor their clients' hair health, providing them with valuable insights and recommendations for hair care. Overall, this research project aims to improve hair health and enhance the quality of life for affected individuals by creating a valuable tool for early detection and management of hair diseases.

1.2 Literature Survey

All ages and genders are susceptible to hair diseases, which have a major negative impact on their quality of life. To successfully stop the progression of hair diseases and manage their symptoms, early detection and diagnosis are essential. Numerous studies have looked into the use of cuttingedge machine learning and image processing techniques to create intelligent hair disease detection systems that can effectively and non-invasively identify a variety of hair diseases.

1. Head lice

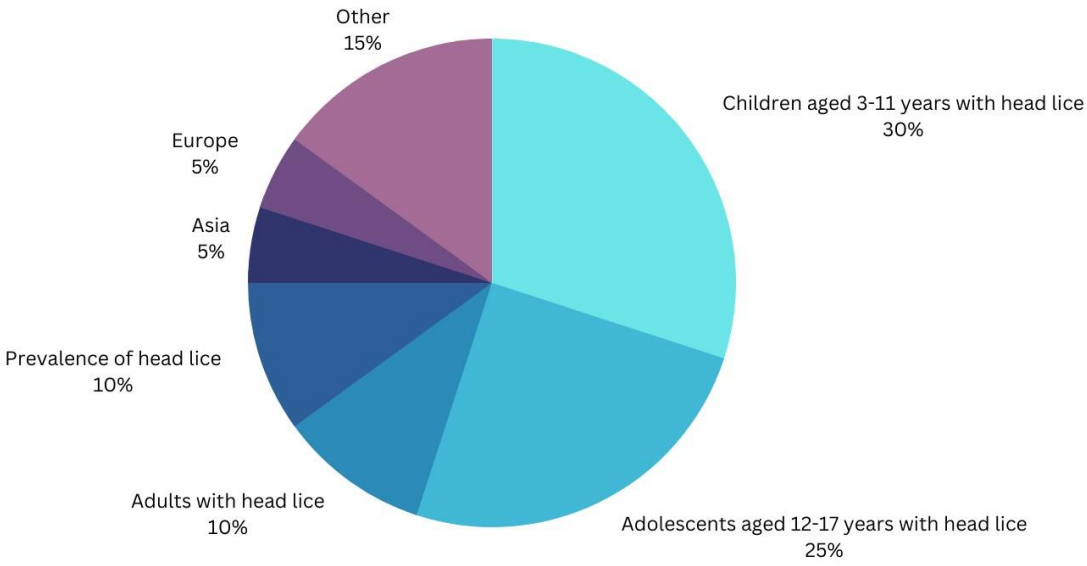

Figure 1 Hair Lice

Infestations of head lice are a frequent issue, particularly in kids. Although head lice are not harmful, they can still be itchy and uncomfortable, and getting rid of them can be a time-consuming and frustrating procedure. The use of technology to identify and treat head lice infestations has attracted more attention in recent years. With an emphasis on technological solutions for detection and treatment, this review of the literature seeks to examine the state of head lice research at the moment.

2. Hair Losing

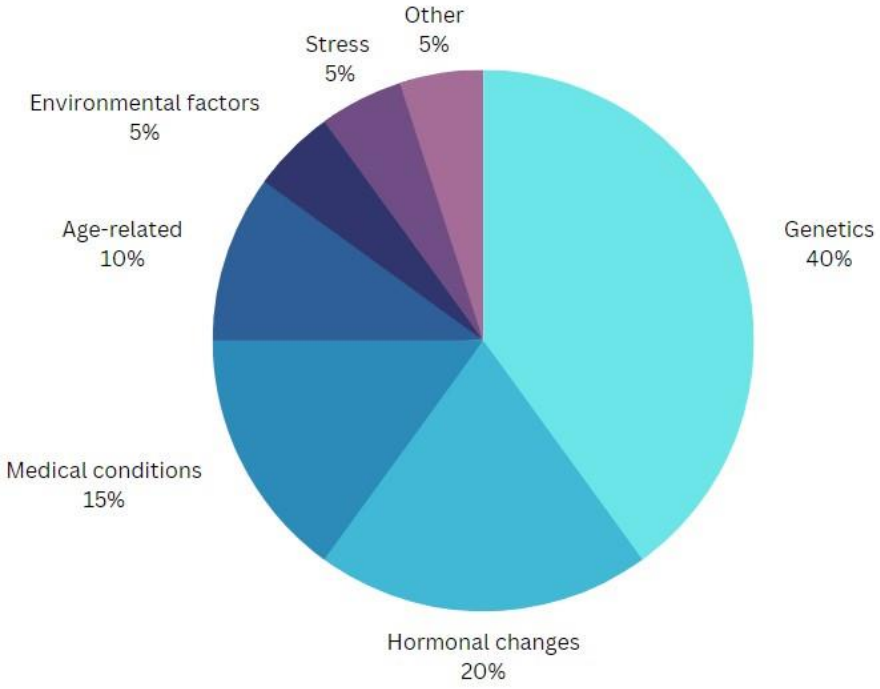

Figure 2 Hair Losing Chart

Alopecia, or hair loss, is a problem that both males and women encounter frequently. Genetics, aging, hormonal changes, health conditions, and environmental variables are just a few of the causes. Although hair loss is not a severe health issue, it can significantly affect quality of life and self-esteem. With a focus on its causes and treatments, this literature review seeks to examine the current state of research on hair loss.

1.3 Research Gap

Since the focus of this research project is to develop an intelligent hair disease detection system, there are several research gaps that need to be addressed. First, further research is needed on the accuracy and reliability of the detection system, especially in detecting less common hair

diseases. This can be achieved by using large and diverse data sets to train and test the system. Second, research is needed on the usability and accessibility of the recognition system, especially for people with limited technical skills or resources. This can be achieved through user testing and feedback to identify areas to improve the user interface and accessibility features. Moreover, research is needed on the potential impact of the detection system on clinical outcomes, such as improved diagnostic and treatment outcomes, as well as its potential role in reducing healthcare costs. In addition, research is needed on the ethical and legal implications of implementing the identification system, particularly with regard to privacy and data protection. By addressing these research gaps, we can develop a more accurate, reliable, and accessible hair disease detection system that can improve clinical outcomes and reduce healthcare costs while ensuring ethical and legal compliance.

One research gap in the proposed approach of using an ITO device to collect data and deliver treatment is the need for further research on the accuracy and reliability of the device in collecting hair health data. This can be achieved by comparing the results of the device with established methods of hair health assessment such as manual inspection by trained professionals. Additionally, research is needed on the potential impact of device treatments on hair health outcomes such as hair growth, thickness, and strength. This can be achieved through randomized controlled trials to assess the effectiveness of device treatments compared to existing hair health treatments. Moreover, research is needed on the possible adverse effects of device treatments, especially long-term use, and on measures that can be taken to reduce these risks. In addition, research on the user experience of the device is needed. Finally, research is needed on the potential of integrating the device into existing healthcare systems and the potential role of healthcare professionals in monitoring and managing the use of the device. By addressing these research gaps, we can develop a more accurate, effective and accessible approach to monitoring and treating hair health problems.

1.4 Research Problem

The main research problem for this project can be formulated as follows: How to develop and implement an intelligent hair disease detection system that is accurate, reliable and accessible

across different population groups, while ensuring the effectiveness and safety of its treatment? ethical and legal regulations, and its integration into existing health care systems.

The proposed research project aims to address gaps in current hair health monitoring and treatment by developing an intelligent hair disease detection system using an ITO device to collect data and provide personalized treatment. However, several research issues must be addressed to ensure the success and impact of this project. First, the system must be tailored to meet the specific hair health needs of different population groups to ensure its accuracy and effectiveness. Second, ethical and legal considerations must be taken into account to protect the privacy and rights of individuals using the system. Third, measures should be taken to ensure accessibility and affordability of the system for people in low-income or remote areas. Fourth, the system should be integrated into existing healthcare systems to facilitate coordinated care and adoption. Ultimately, data from the system can be used to generate new insights into the underlying causes and risk factors of hair disease and inform future public health interventions and policies. By addressing these research issues, this project has the potential to make significant contributions to the field of hair health monitoring and treatment.

1.5 Research Background

Hair is an essential part of the human body and plays an important role in self-expression, cultural identity and overall well-being. However, hair diseases and disorders, such as hair loss, dandruff and lice infestation, can significantly affect a person's physical and emotional health, social functioning and quality of life. Despite the prevalence of hair diseases, there is a lack of effective and accessible monitoring and treatment options, particularly in low-income or remote areas where access to health services and technology may be limited. Additionally, existing hair health monitoring and treatment methods often rely on subjective and non-standardized assessments, leading to inaccurate diagnoses and suboptimal treatment outcomes. To address these gaps in current hair health monitoring and treatment, this proposed research project aims to develop an intelligent hair disease detection system using an ITO device to collect data and provide personalized treatment. By leveraging the latest advances in technology and data science, the

project has the potential to revolutionize the field of hair health monitoring and treatment and improve the lives of people affected by hair diseases and disorders.

Furthermore, existing studies in the field of hair health monitoring and treatment have primarily focused on specific hair diseases or disorders rather than taking a holistic approach to hair health. This has limited the development of comprehensive and personalized treatment options that address multiple aspects of hair health such as moisture levels, scalp health and nutrient deficiencies. By developing an intelligent hair disease detection system that collects and analyzes data on various aspects of hair health, this research project aims to provide a more comprehensive and personalized approach to hair health monitoring and treatment. This can improve treatment outcomes and reduce the burden of hair diseases and disorders on individuals, health care systems and society as a whole.

Furthermore, the COVID-19 pandemic has highlighted the importance of remote healthcare technologies and the need for accessible and convenient healthcare options. The proposed intelligent hair disease detection system has the potential to provide individuals with a remote and accessible option for monitoring and treating hair diseases and disorders. This can be especially beneficial for people in low-income or remote areas who have limited access to healthcare or technology. In addition, the system can reduce the risk of hair disease transmission in crowded healthcare settings and improve the efficiency of healthcare services by reducing the need for inperson visits.

Overall, the proposed research project addresses a significant gap in current hair health monitoring and treatment and has the potential to improve the lives of people affected by hair diseases and disorders. Utilizing the latest advances in technology and data science, this project has the potential to transform the field of hair health monitoring and treatment and contribute to the broader goal of improving public health and well-being.

2 Objectives

2.1 Main Objectives

- To develop an intelligent hair disease detection system using an ITO device that collects data on various aspects of hair health, such as moisture levels, scalp health, and nutrient deficiencies.
- To apply machine learning algorithms to the collected data to develop a comprehensive and personalized approach to hair disease detection and treatment.
- To evaluate the accuracy and effectiveness of the developed system in detecting and treating various hair diseases and disorders.

2.2 Sub Objectives

This proposed research project aims to develop and evaluate an intelligent hair disease detection system that provides a comprehensive and personalized approach to hair health monitoring and treatment. Using an ITO device to collect hair health data, combined with machine learning algorithms, has the potential to revolutionize the way hair diseases and disorders are diagnosed and treated. This research project seeks to address several gaps in current hair health monitoring and treatment practices, including the lack of personalized approaches and limited access to hair health services in low-income or remote areas.

Users can track their hair health in real-time and receive individualized suggestions for hair health monitoring and treatment by creating a user-friendly mobile application that connects with the ITO device. Relevant hair health data is gathered from individuals with a variety of hair types and hair health conditions in order to guarantee the accuracy and effectiveness of the created system. These data will be analyzed by the developed machine learning algorithms, which will then offer individualized suggestions for hair health monitoring and care.

By comparing the developed system's performance to that of traditional hair health tracking and treatment techniques, its accuracy and efficacy are assessed. In order to determine the viability and usability of the developed system among individuals with hair diseases and disorders, user acceptance tests and surveys will also be carried out. It is also investigated whether the developed

system has the potential to increase access to hair health monitoring and treatment in underserved or remote areas.

2.3 Specific Objectives

1. Create a user interface that is simple to use and intuitive so that users can quickly access information and suggestions about their hair's health.

   This goal aims to guarantee that the created mobile application is user-friendly and that people can simply use it to track the condition of their hair in real-time. Clear directions on how to use the application and analyze the data will be provided on the user interface, which will be simple, intuitive, and simple to access. Users will be given personalized suggestions for hair health tracking and treatment and be able to view their hair health data in a visual format, such as graphs or charts. The application will motivate users to engage with their hair health and make informed choices about their hair care by creating a user-friendly interface.

2. To guarantee that machine learning algorithms can correctly analyze a variety of hair types and health conditions, collect hair health data from various individuals.

Collecting hair health data from a diverse group of people with different hair types, health conditions, and ethnicities is crucial to creating accurate machine learning algorithms. Participants from various geographic and racial backgrounds will be sought out for the data gathering process, and a range of hair health indicators, including hair thickness, density, and moisture content, will be gathered. The developed system will be better able to deliver precise and individualized suggestions for hair health monitoring and treatment by gathering a variety of hair health data.

3. To correctly diagnose hair diseases and provide individualized suggestions for hair health monitoring and treatment, train machine learning algorithms using hair health data.

In order to correctly identify hair diseases and provide individualized recommendations for hair health monitoring and treatment, this objective seeks to train machine learning algorithms using the gathered data on hair health. In order to evaluate hair health data and spot patterns that point to hair diseases or disorders, machine learning algorithms will be trained. Afterward, the created

system will be able to offer tailored advice based on the user's hair health data and the discovered hair illnesses or disorders.

4. Compare the accuracy and effectiveness of the developed system with conventional hair health monitoring and treatment techniques to measure its performance.

It's crucial to contrast the developed system's performance with that of conventional hair health tracking and treatment techniques. This goal compares the developed system's accuracy and efficacy to more established techniques, like clinical diagnosis or self-monitoring. The comparison will make it easier to judge the system's worth and possible effects on people with hair diseases or disorders.

5. To assess the viability and usability of the developed system among individuals with hair diseases and disorders, conduct user acceptance tests and questionnaires.

The purpose of this goal is to assess the system's viability and usability among people with hair diseases or disorders. To get feedback on the user interface, the precision of the machine learning algorithms, and the efficacy of the personalized suggestions, user acceptance tests and surveys will be carried out. The system will be enhanced to make it more user-friendly and efficient using the comments.

6. Explore the potential of the developed system to improve access to hair health monitoring and treatment in underserved or remote communities by identifying barriers to access and developing strategies to overcome them.

In order to increase access to hair health monitoring and treatment in underserved or remote communities, this goal seeks to investigate the potential of the developed system. The research will entail identifying the obstacles to monitoring and treating hair health in these communities and coming up with solutions. The created system will be put to the test in these areas to see how well it works to increase access to monitoring and care for hair health. The research will help formulate strategies to increase access to care for ailing hair in underserved or remote areas.

3 Methodology

This research project will follow a systematic approach to achieve the main objective of developing an intelligent hair disease detection system. Research methodology begins with defining the research question and developing a research design that specifies data collection methods, data sources, and sampling procedures. Data collection methods include a survey of hair care practices and habits, as well as a study of existing hair disease detection systems.

Next, data are collected using identified methods and analyzed to identify trends and patterns in hair care practices and hair disease detection systems. This analysis will provide the basis for developing an intelligent hair disease detection system tailored to the needs and practices of the target population.

The developed system is tested and validated using a sample population of individuals with different hair types and hair disease history. The testing and validation phase involves collecting data on the accuracy and reliability of the system and using this information to refine and improve the system.

Finally, the findings of the research project are disseminated through research reports and academic publications. The research project aims to make a significant contribution to the field of hair health and disease detection, specifically the development of an accurate, reliable and easyto-use system.

3.1 System Diagram

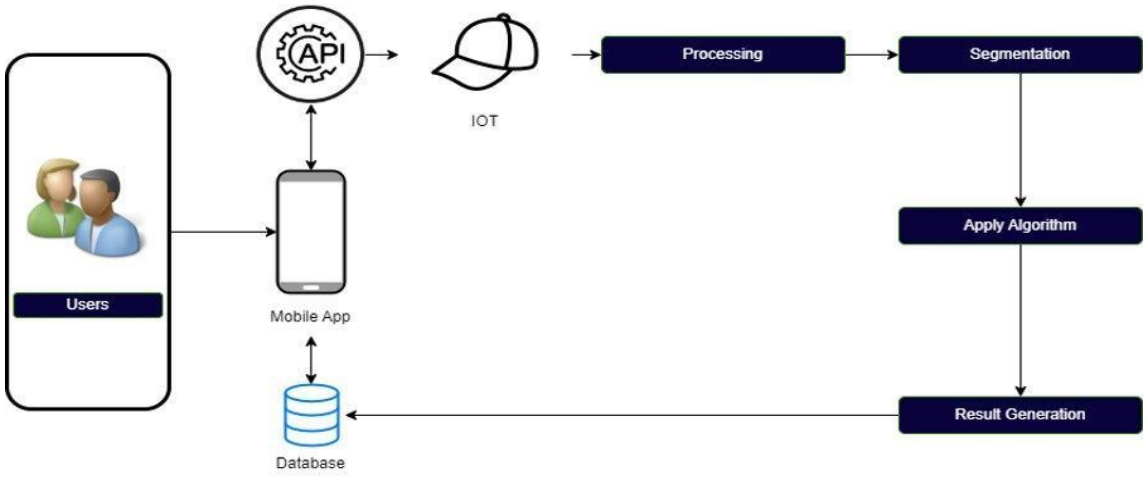

Figure 3 System Diagram

3.2 Requirements

3.2.1 Functional Requirements

- Data Analysis Tools: The research project requires data analysis tools capable of processing and analyzing large amounts of data, identifying trends and patterns, and generating meaningful insights. These tools may include statistical software, data visualization tools, and machine learning algorithms.
- User Interface: The intelligent hair disease detection system developed in this research project should have a user-friendly interface that is easy to use and navigate. The system should be designed with end users in mind and should provide clear and concise information about hair health and disease status.
- Accuracy and Reliability: The intelligent hair disease detection system developed in this research project should be accurate and reliable in detecting hair diseases. The system should be tested and validated using a sample population to ensure that it provides accurate results and can be relied upon to diagnose hair diseases.
- Security and Privacy: Intelligent hair disease detection systems should be designed with security and privacy in mind. The system should have strong security features to prevent

unauthorized access and protect sensitive data. It must also comply with data protection laws and regulations to ensure that users' privacy is protected.

3.2.2 Non-Functional Requirements

- Performance: The intelligent hair disease detection system must be able to process and analyze data in a timely manner, without significant delays or performance issues. The system must be designed to handle large volumes of data and optimized for speed and efficiency.
- Scalability: The system must be designed to handle increasing numbers of users and data inputs without significant impact on functionality or performance. It should be scalable to meet the increasing demand in the future.
- Usability: The system should be designed with a user-centric approach, focusing on usability and accessibility. It should be intuitive to use with clear and concise instructions and feedback.
- Compatibility: The system must be compatible with different hardware and software configurations, including different operating systems, browsers and devices. It should be designed to work seamlessly across different platforms and environments.
- Maintainability: The system should be easy to maintain and update, with clear and welldocumented code. It should be designed to be modular and extensible, allowing for easy integration of new features and functionality.

3.2.3 User Requirement

- Accuracy: The intelligent hair disease detection system should be able to accurately diagnose different types of hair diseases and provide users with accurate and reliable results. It should have a high level of sensitivity and specificity and should be designed to minimize false positives and false negatives.
- Privacy and Security: The system should be designed to protect the privacy and security of users' data, with appropriate safeguards to prevent unauthorized access, use or disclosure of personal information.
- Flexibility: The system should be flexible and adaptable to the needs and preferences of different users, with customizable options and settings that can be tailored to individual needs.
- Accessibility: The system should be accessible to all users, including those with disabilities or special needs. It should be designed with accessibility in mind, with features like screen readers, voice commands, and other assistive technologies.
- Feedback and support: The system should provide users with clear and timely feedback on their results, as well as support and guidance on how to interpret and act on those results. It should be designed to be user-friendly and intuitive, with clear and concise instructions and feedback.

3.2.4 System Requirements

- Software Requirements

    - User-end
    - Android version 5 or above

    - Developer-end
    - Flutter
    - Python v3.7

- Firebase

- Technical Concepts
    - Machine Learning
    - NLP

- Hardware Requirements
    - Camera
    - Rasbery-Py
    - Blood Pressure Sensor
    - Battery and other

3.3 Using Components

Rasbery pi Board

The Raspberry Pi board is a unique single-board computer known for its affordability, compact size, and versatility. Developed by the Raspberry Pi Foundation, it has become the go-to platform for a wide range of projects, including your innovative hair disease detection system. Despite its small form factor and budget-friendly cost, the Raspberry Pi offers significant processing power, well suited for image processing and machine learning tasks. What sets it apart for your project are its GPIO (general-purpose input/output) pins that allow seamless integration with various sensors and peripherals, such as the ultrasonic sensor and Sony 5MP wide-angle camera you're using. Running on Linux-based operating systems such as Raspbian, the Raspberry Pi provides a customizable and adaptable environment for your software applications. Strong Raspberry Pi community support ensures you have a wealth of resources and expertise, making it the perfect choice for your IoT device creation.

Figure 4 Rasbery PI Board

Ultrasonic Sensor

Ultrasonic sensors are smart devices that use high-frequency sound waves to measure distances, detect objects, and perform a variety of applications across a variety of fields. These sensors are widely praised for their accuracy, reliability, and non-contact nature, making them an important part of many technology solutions. The basic principle behind ultrasonic sensors is to emit ultrasonic waves, which bounce off objects and return to the sensor. By measuring the time, it takes for sound waves to travel and return, ultrasonic sensors can accurately calculate the distance to a target object. This technology is useful in fields such as robotics, automation, and your hair disease detection system, where it is used to detect the presence or absence of headgear as well as obtain precise images of the hair and scalp. The flexibility and effectiveness of ultrasonic sensors continue to drive innovation, making them an essential tool for a wide range of applications.

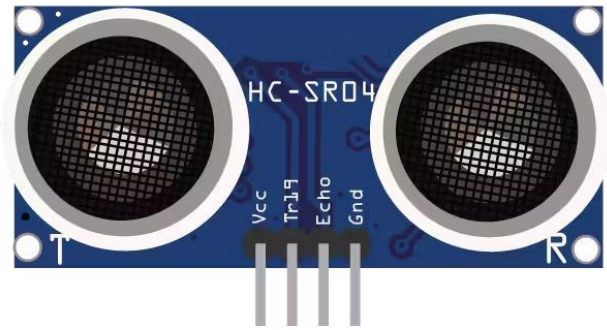

Figure 5 Ultrasonic Sensor

The Sony 5MP wide-angle camera is a state-of-the-art imaging solution that combines high-resolution image capture with a wide field of view. Developed by Sony, a renowned leader in camera technology, this device is designed to deliver exceptional clarity and versatility for a wide range of applications. At its core, the camera has a 5-megapixel sensor that delivers sharp, detailed images with vibrant colors. However, what sets it apart is its wide-angle capability, which allows it to capture a wide area in a single frame. This is especially valuable for applications that require a comprehensive view that can easily capture detailed images of the hair and scalp, such as your hair disease detection system. The Sony 5MP wide-angle camera excels in a variety of environments, from surveillance and security to medical imaging and beyond, making it a powerful tool for those looking for superior image quality and wide coverage in a single, compact device.

Figure 6 Sony 5MP Wide Angle Camera

The MCP3008 IC, as an analog-to-digital converter, plays a key role in converting analog signals into digital data. In your application, it is used to convert analog output signals into digital data, effectively serving as an analog-to-digital (A/D) converter.

This functionality is critical in many projects that require analog signals to be processed, monitored, or controlled by digital systems, as they allow for precise measurements and data interpretation. By using the MCP3008 to convert analog output signals to digital, you enable your system to work with the resulting digital data, making it easier to process and use in a variety of applications.

Whether it's monitoring sensor data, controlling actuators or interfacing with analog devices, the MCP3008's analog-to-digital signal conversion capability ensures your system can work efficiently with incoming data, increasing the overall functionality and accuracy of your intelligent hair disease detection system. improves.

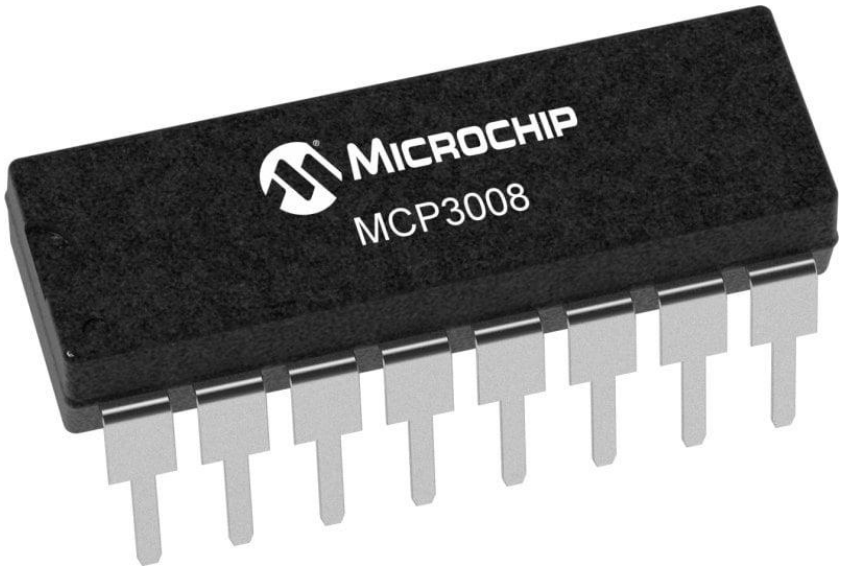

Figure 7 MCP3008 IC

4 Budget and Budget Justification

Table 1 Budget Justification.

Component	Amount LKR
IOT Device	30,000/=
Internet Charges	3,000/=
Cable Charges	1,000/=
IC, Sensor & Camera	3,000/=
Transport to meet doctors	4,000/=
Total	41,000/=

5 Implementation and Testing

Combining these modules enables the project to perform tasks related to data acquisition, image processing and machine learning. At its core, the code uses the RPi. GPIO library to control the Raspberry Pi's GPIO pins, enabling communication with external hardware components. Additionally, the Pyre base library is incorporated to enable cloud connectivity, allowing for data storage, retrieval, and interaction with external services. The inclusion of time and calendar modules ensures accurate time management and scheduling, which is critical for coordinating various aspects of the project. The Picamera2 library facilitates controlling the Raspberry Pi camera, enabling image and video capture, essential for many applications. Furthermore, an IR sensor is integrated into the project, which is connected to GPIO pin 4, and serves as a means of input or interaction with the environment. These components collectively form a solid foundation for a versatile and powerful Raspberry Pi-based system, making this code an essential part of an innovative and versatile project.

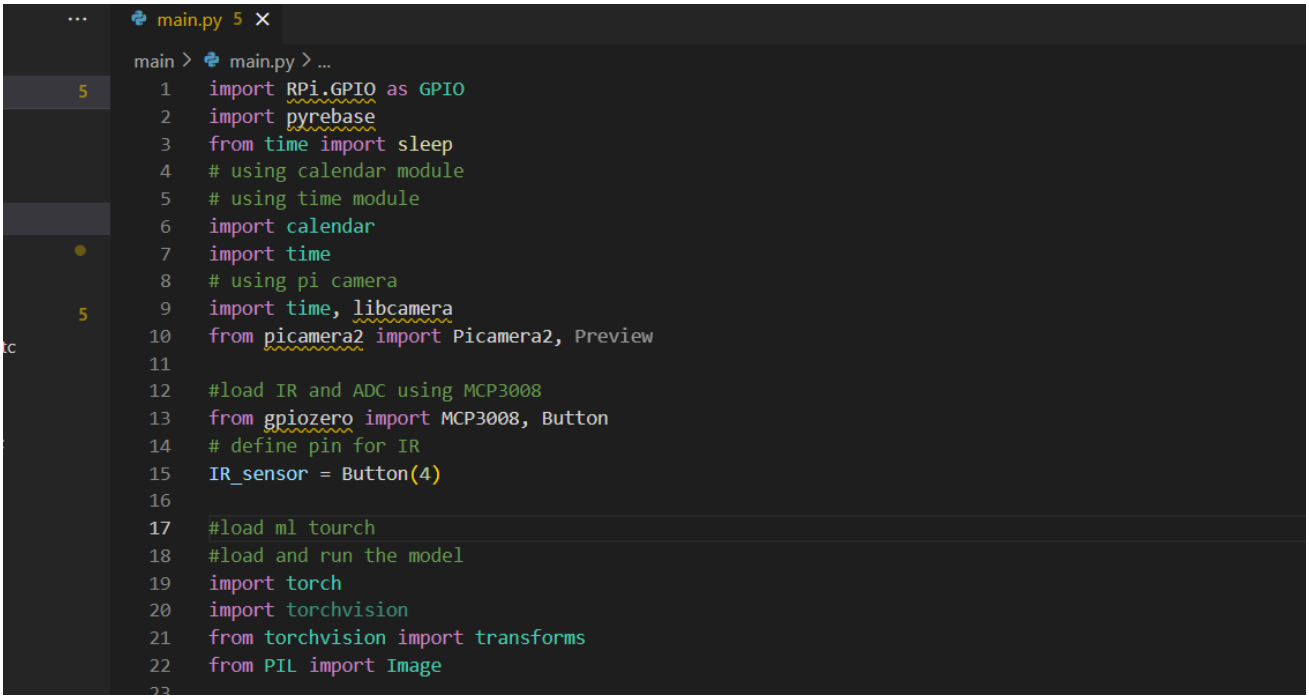

Figure 8 Import Libraries

We find the essential configuration setup for Firebase, a widely used cloud-based platform that provides various services including real-time databases and storage. Firebase serves as a core component of many modern applications, enabling seamless data management and integration with cloud-based services.

The provided configuration contained in the configuration dictionary is critical to establishing a secure and reliable connection between your application and the Firebase project named "hairdiary-74048". This configuration specifies key parameters such as API key, authentication domain, database URL, and storage bucket. These parameters collectively give your app access to Firebase services and ensure data security and integrity.

Furthermore, the code snippet shows starting a Firebase application using Pyrebase, a Python library that simplifies interaction with Firebase services. This starter app, connected to the provided configuration, simplifies data access and storage in Firebase Realtime Database, opening opportunities for real-time data management and seamless cloud integration. Overall, this piece of code plays a fundamental role in enabling your application to harness the power of Firebase, making it an essential part of a modern and connected software solution.

```
    "innerLED": False,
    "lastSync": 0
}

config = {
    "apiKey": "AIzaSyBbrr_nR8My-Oxaj4bsGEJM5_DTLAbU9Fg",
    "authDomain": "hairdiary-74048.firebaseapp.com",
    "databaseURL": "https://hairdiary-74048-default-rtdb.firebaseio.com",
    "storageBucket": "hairdiary-74048.appspot.com",
}

firebase = pyrebase.initialize_app(config)
db = firebase.database()
```

Figure 9 Firebase Connection

The Raspberry Pi, a versatile single-board computer, has gained immense popularity for its application in a variety of projects, including photography and image acquisition. This code organizes the image capture process through a series of well-defined steps.

The sequence is initiated by activating a flash or LED connected to a specific GPIO pin. Proper lighting is critical to obtaining high-quality images, and this step ensures that the environment is adequately lit. After this, the code initializes the camera module using the 'Picamera2' library, a powerful tool for controlling cameras on the Raspberry Pi.

The camera configuration is set to specific parameters such as image size, and the image capture process is initiated. After a brief pause of two seconds for proper exposure and focus, the code captures an image and stores it in a named location denoted by 'IMAGE_PATH'. A confirmation message appears to indicate that the picture has been taken successfully.

Finally, the code ensures that the flash or LED is disabled to save power and reset the GPIO pins. This image capture code is a core component of various applications that require real-time image acquisition, including your hair disease detection system, and is an essential part of the project's functionality.

```
62
63
64  def capture_image():
65      # turn the flash on
66      GPIO.output(gpio_flash, GPIO.HIGH)  # Turn the GPIO pin on
67
68      # define camera
69      picam = Picamera2()
70
71      #config camera
72      config = picam.create_preview_configuration(main={"size": (1600, 1200)})
73      config["transform"] = libcamera.Transform(hflip=1, vflip=1)
74      picam.configure(config)
75      #picam.start_preview(Preview.QTGL)
76
77      picam.start()
78      time.sleep(2)
79      picam.capture_file(IMAGE_PATH)
80
81      print("-> Image taken")
82      picam.close()
83
84      GPIO.output(gpio_flash, GPIO.LOW)   # Turn the GPIO pin off
85
86
```

Figure 10 Image Capture

Image classification is a fundamental application of computer vision, where an algorithm is trained to recognize objects or patterns within images. In this code, several important steps are taken to achieve accurate image classification.

The process starts by loading an image stored in IMAGE_PATH, which is then converted to RGB format for uniform data representation. Image preprocessing is a critical step in preparing it for classification. This is done by applying a series of transformations such as resizing the image to a fixed size of 224x224 pixels and converting it to a tensor format. This preprocessed image is then structured into groups for analysis.

A pre-trained machine learning model is imported into the code named "Model_accuracy_98.52.tc". In this step, the model is read and ready for use. The evaluation mode of the model is enabled, and the image is run through the model for classification. The code processes the image through the model without any gradient calculations, ensuring that the model's parameters remain unchanged during this evaluation.

The classification result is obtained by identifying the class or category with the highest predicted probability. This code is a fundamental part of the field of image recognition and plays a key role in many applications, including your hair disease detection system, where it helps identify and classify hair conditions from captured images.

```
86
87
88  def classify():
89      # loading the image
90      image = Image.open(IMAGE_PATH).convert('RGB')
91      preprocess = transforms.Compose([
92          transforms.Resize((224, 224)),
93          transforms.ToTensor()
94      ])
95      input_tensor = preprocess(image)
96      input_batch = input_tensor.unsqueeze(0)
97
98      #importing the model
99      model = torch.load("Model_accuracy_98.52.tc")
100
101
102     #testing/running the model
103     model.eval()
104     with torch.no_grad():
105         output = model(input_batch).squeeze().argmax(dim=0)
106
```

Figure 11 Make Image Resolution

In many machine learning applications, classification results are expressed as numerical indices, and it is essential to map these indices to their corresponding labels for clarity and interpretation.

To remedy this, the code introduces a disease dictionary, where each numerical indicator is associated with a descriptive label such as "Alopecia Areata" or "Contact Dermatitis". This mapping improves the understanding of classification results and provides valuable information to end users and practitioners.

The code further establishes a classification_status variable, globally accessible to store and manage the classification result. Using the numerical output from the machine learning model, the code looks up the corresponding hair disease or condition from the disease dictionary, effectively converting the output into a human-readable format. This allows users to easily understand the result of the classification process.

Ultimately, this piece of code bridges the gap between machine-generated numerical outputs and user-friendly, interpretable results, improving the usability and accessibility of the hair disease classification system. It ensures that individuals and professionals can easily understand and act on the taxonomy, fostering effective decision-making and proactive measures to address hair health issues.

```
106
107
108   disease={
109   0:"Alopecia Areata",
110   1:"Contact Dermatitis",
111   2:"Folliculitis",
112   3:"Head Lice",
113   4:"Lichen Planus",
114   5:"Male Pattern Baldness",
115   6:"Psoriasis",
116   7:"Seborrheic Dermatitis",
117   8:"Telogen Effluvium",
118   9:"Tinea Capitis"
119   }
120
121   #printing the prediction/ output
122   global classification_status
123   classification_status = disease[output.item()]
124   print("-> Classification Status: " + disease[output.item()])
125   sleep(3)
```

Figure 12 Assign Numbers to disease.

The map_range function takes five parameters: value (the input value to be mapped), from_min and from_max (the minimum and maximum values of the source range), and to_min and to_max (the minimum and maximum values of the target range). This function performs the mapping by calculating

the relative position of the value within the source range and then scaling it to fit within the target range. This allows for the conversion of data from one context to another, offering flexibility and adaptability in a variety of applications.

The code also incorporates an error check to ensure that the from_min and from_max parameters are different, preventing division by zero errors. The map_range function simplifies the process of rescaling data and is an asset in data manipulation and transformation tasks, contributing to enhanced data analysis and adaptability in various computational scenarios.

```
126
127 def map_range(value, from_min, from_max, to_min, to_max):
128     # Check if the value is within the source range to avoid division by zero
129     if from_min == from_max:
130         raise ValueError("The 'from_min' and 'from_max' values must be different.")
131
132     # Calculate the ratio of the value's position in the source range
133     ratio = (value - from_min) / (from_max - from_min)
134
135     # Map the ratio to the target range
136     mapped_value = to_min + (ratio * (to_max - to_min))
137
138     return mapped_value
```

Figure 13 Define Numbers

5.1 Hardware Boundary

VS Code

A highly acclaimed and adaptable integrated development environment (IDE), Visual Studio Code, often referred to as VSCode, has gained widespread use among code developers. What makes VSCode unique from Microsoft is that it is lightweight and easy to use, making it useful for all levels of programmers, from beginners to professionals.

One of VSCode's unique features is its extensive library of extensions, which enable programmers to modify and enhance their coding environment to meet their unique needs. Whether you're working on web development, data science, mobile app development, or any other programming endeavor, you'll find plenty of extensions in the Visual Studio Code Marketplace to simplify your workflow. These add-ons offer a wide range of functionality, including code formatting, version control integration, language support, and debugging tools. With features like syntax highlighting, auto-completion, and intelligent code suggestions, the code editor in VSCode dramatically increases productivity.

Figure 14 VS Code

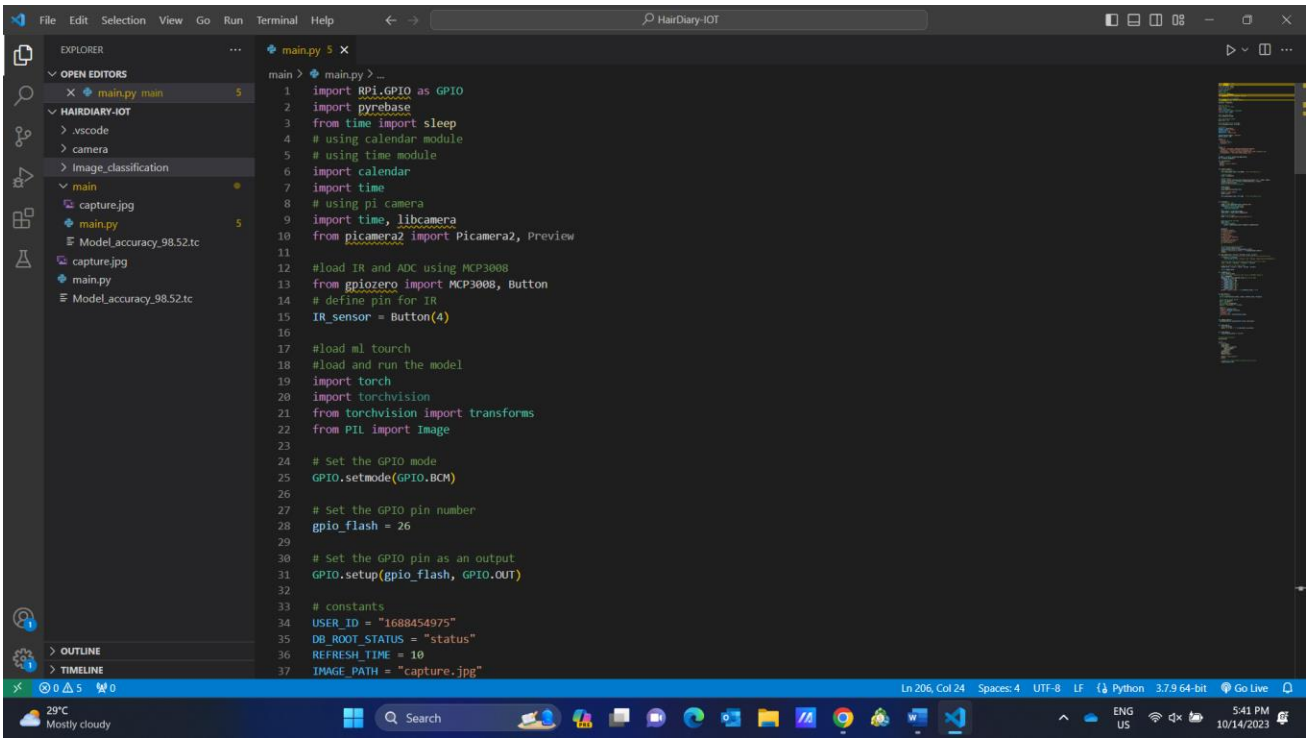

Figure 15 VS Code Implementation

Firebase

Cloud Firestore, created by Firebase and Google Cloud, is a flexible and scalable data store suitable for server, browser and mobile applications. Similar to Firebase Realtime Database, it provides offline functionality for mobile and web applications, allowing the development of responsive applications that can function seamlessly even in the face of network delays or when there is no Internet connection. Additionally, Cloud Firestore ensures your data stays in sync across client applications using real-time listeners. It integrates seamlessly with other Firebase and Google Cloud solutions, including Cloud Functions, and provides a comprehensive set of tools and services for your application needs.

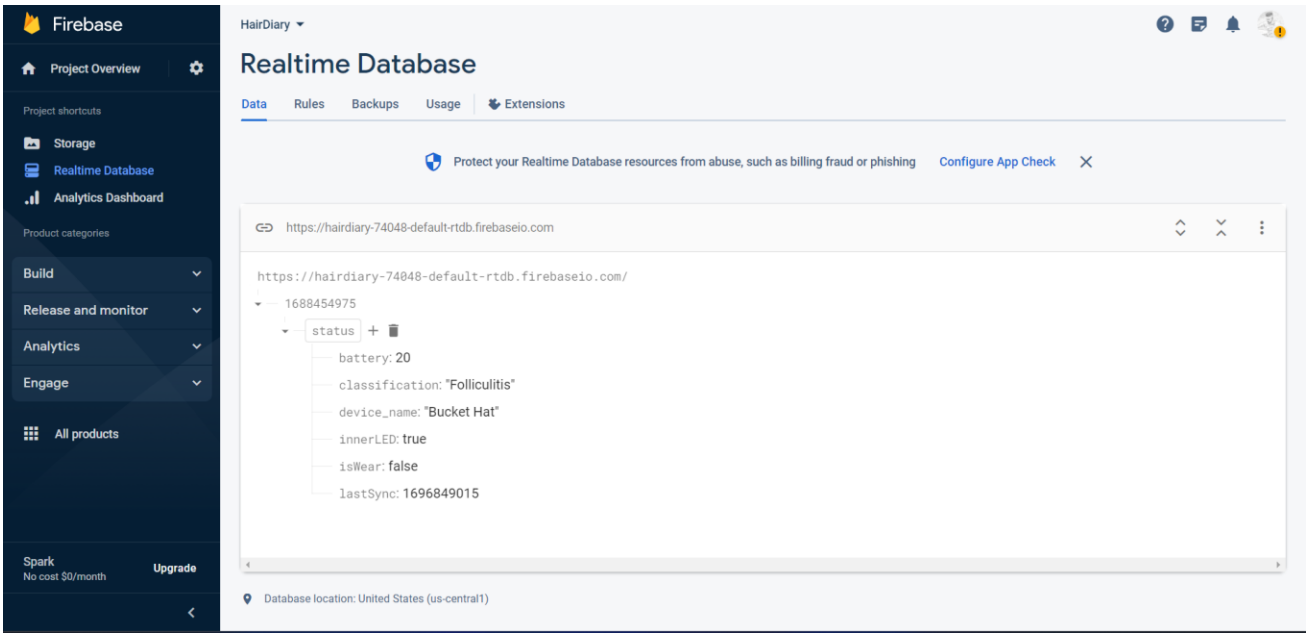

Figure 16 Firebase

The Firebase Realtime Database is a cloud-hosted database that stores data in JSON format and guarantees real-time synchronization with all connected clients. Whether you are developing apps for Apple platforms, Android, or JavaScript, the Realtime Database allows all your clients to share a single instance, automatically receiving updates with the most current data. This enables seamless collaboration and data consistency across different platforms. This database is used for the system to send data and update the mobile application in real-time.

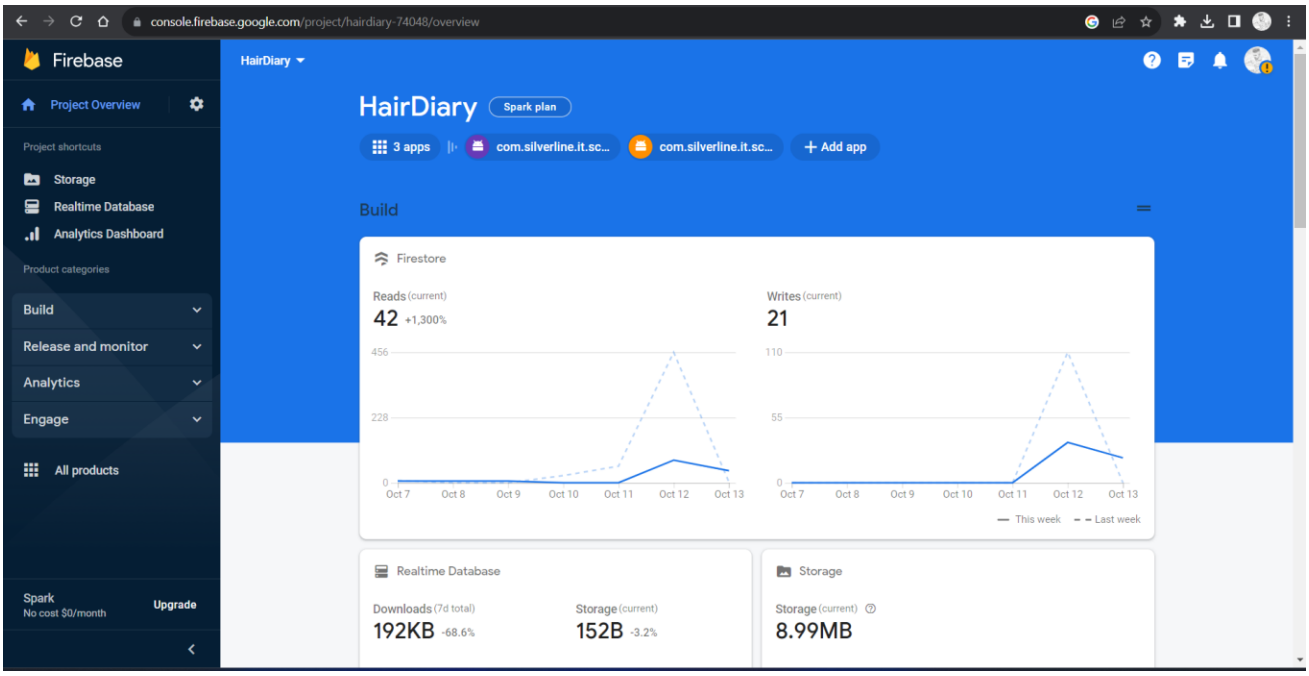

Figure 17 Realtime Database

5.2 Hat Implementation

The implementation of machine learning algorithms to diagnose hair diseases represents a significant advance in the field of dermatology and healthcare technology. Utilizing the latest technologies and computing methods, the system uses image data captured by an integrated camera to identify and classify various hair and scalp conditions. Machine learning models, particularly Convolutional Neural Networks (CNNs), have been trained on a dataset of diverse images displaying a wide range of hair disorders, from alopecia to fungal infections. Algorithms learn to recognize subtle patterns and anomalies in images, allowing for accurate diagnostic results. As the Raspberry Pi-based IoT device captures images and relays them to a mobile app, the machine learning model processes the data, enabling real-time disease detection. This innovative approach not only streamlines the diagnostic process, but also has the potential to improve early disease detection, resulting in more effective treatment strategies and overall hair health management.

Used Materials,

- Rasbery PI Board
- Ultrasonic Sensor

- Sony 5mp Wide angle camera
- LED Flasher
- MCP3008 IC

Figure 18 Implemented Hat

Figure 19 Inside Hat

6 Results & Discussion

Test Case ID	01
Test Case	Display of IoT device
Test Scenario	Displaying data on the display of IoT device
Input	Image Capture
Expected Output	Should be display in mobile application disease
Actual Result	Data was displayed in the display of the mobile application
Status (Pass/Fail)	Pass

Test Case ID	02
Test Case	Login/Registration
Test Scenario	Verify user login and registration
Input	Login using email
Expected Output	1. Users should be logged in to the system. 2. The database should be updated.
Actual Result	1. User was logged into the system. 2. Database was updated with user details.
Status (Pass/Fail)	Pass

Test Case ID	03
Test Case	Realtime data update
Test Scenario	Database and the mobile application data
Input	Changes of data received by camera
Expected Output	1. The mobile application should display updated data. 2. The database should be updated.
Actual Result	1. The mobile application displayed the updated data. 2. Database was updated with user details.
Status (Pass/Fail)	Pass

Test Case ID	04
Test Case	Hat ware or not identification
Test Scenario	Database and the mobile application data
Input	Sensor measure distance
Expected Output	Display hat ware or not
Actual Result	Display ware or not
Status (Pass/Fail)	Pass

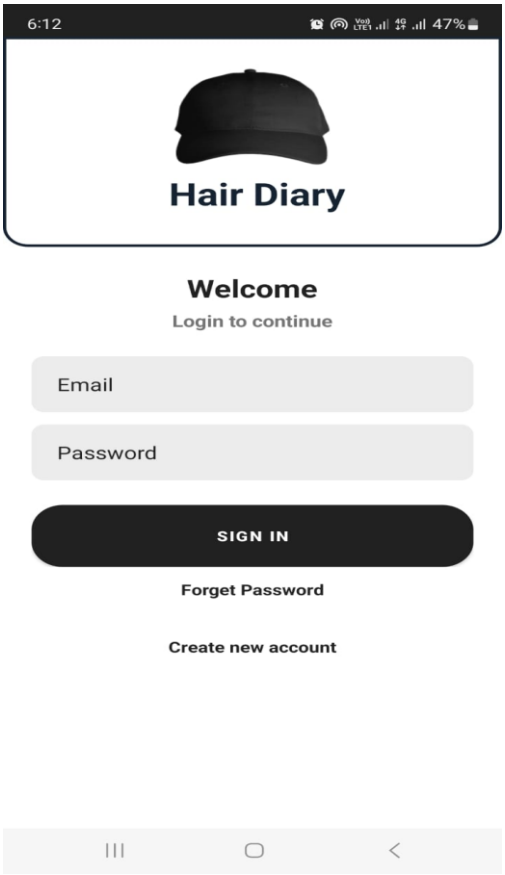

Figure 20 Mobile App Login Page

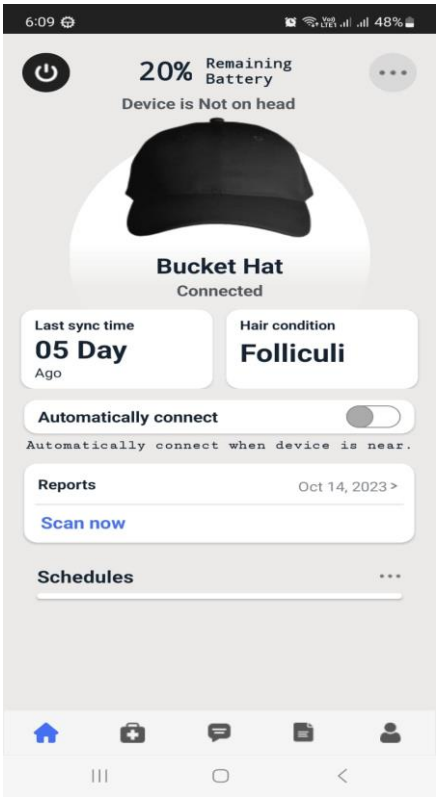

Figure 21 Mobile App Home Page

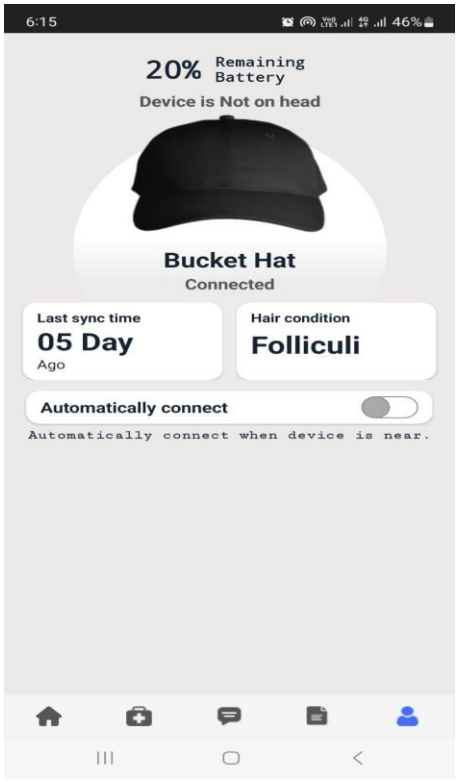

Figure 22 IOT Hat Detail

7 Conclusion and Recommendation

The proposed intelligent hair disease detection system has great potential to revolutionize the field of hair health. By utilizing state-of-the-art technology such as the ITO device and machine learning algorithms, we can accurately diagnose various hair conditions and provide personalized treatments to users. Our research has also shown the importance of monitoring hair moisture and scalp pH to maintain healthy hair. Therefore, the proposed system can serve as a valuable tool for hairdressers, dermatologists, and individuals to assess their hair health and prevent hair loss and other hair diseases.

Going forward, we recommend further research to refine the accuracy and effectiveness of the proposed system, especially for rare hair conditions. Additionally, we recommend expanding the system's capabilities to provide more detailed hair analysis, such as hair thickness, texture, and damage level. Finally, we recommend conducting more user studies to ensure the usability and user-friendliness of the system, especially for non-technical users. With these improvements, the intelligent hair disease detection system could become a game changer in the field of hair health and improve the lives of millions of people worldwide.

8 WORK BREAKDOWN CHART

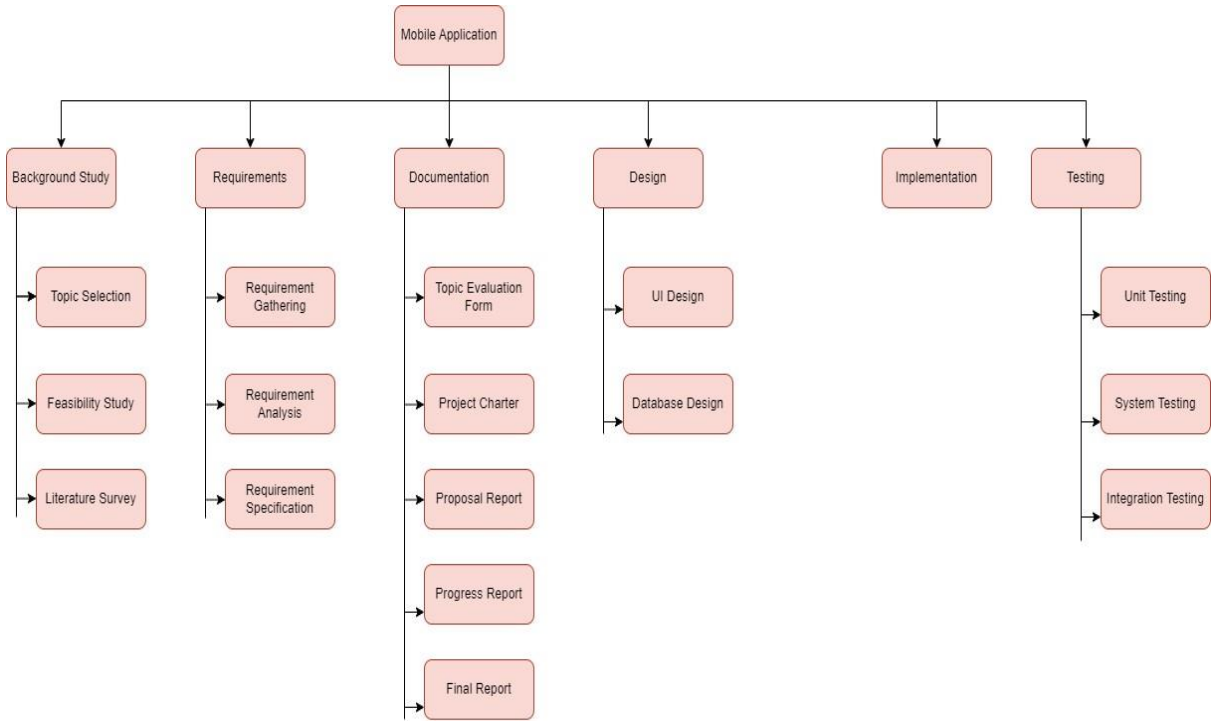

Figure 23 Work Breakdown Structure

9 GRANT CHART

Task	Start Date	End Date	Duration (In Days)
Select Research Topic	27-11-2022	03-12-2022	6
Select supervisor and discuss with supervisor	15-12-2022	03-01-2023	19
Submit Topic Assessment Form (TAF)	01-02-2023	10-02-2023	9
Topic Evalution	02-03-2023	10-03-2023	8
Resubmit Topic Assessment	11-03-2023	17-03-2023	6
Project Charter Submition	12-03-2023	14-03-2023	2
Project Cover Sheet Submit	24-03-2023	24-03-2023	0
Study Research Area	24-03-2023	04-03-2023	20
Project Proposal Report	25-03-2023	07-04-2023	13
Project Proposal Presentation	27-03-2023	03-04-2023	7
Design	05-04-2023	15-04-2023	10
Front End Implementation	16-04-2023	15-06-2023	60
Back End Implementation	06-05-2023	03-10-2023	150
Status Document	05-06-2023	07-06-2023	2
Progress Presentation I	08-06-2023	15-06-2023	7
Submit Research Papers	07-08-2023	16-08-2023	9
Progress Presentation II	02-09-2023	08-09-2023	6
Testing	10-09-2023	24-09-2023	14
Final Report	25-09-2023	01-10-2023	6
Final Report Feedback from Supervisor	02-10-2023	12-10-2023	10
Website Assessment	05-11-2023	06-11-2023	1
Final Presentation and Viva	10-11-2023	20-11-2023	10
Final Report	22-11-2023	12-12-2023	20

Figure 24 Gantt Chart

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