

Project ID :

R24-019

1. Topic (12 words max)

 Remote Health Monitoring: A Revolutionary Software for Autonomous Detection of Pulmonary and Cardiac Abnormalities (**CardioResp AI**)

2. Research group the project belongs to

Software Systems & Technologies (SST)

3. Research area the project belongs to

Bio-Medical and Health Informatics (HI)

4. If a continuation of a previous project:

Project ID	
Year	

5. Brief

description of the research problem including references (200 – 500 words max) – references not included in word count.

According to the World Health Organization (WHO), cardiovascular diseases stand as the leading global cause of mortality [1], accountable for an annual toll of 17.9 million lives [1]. Concurrently, Chronic Obstructive Pulmonary Disease (COPD) ranks as the third leading cause of death worldwide, with 3.23 million fatalities recorded in 2019 [2].

Accessing medical assessment requires individuals to consult with expensive healthcare professionals or invest in prohibitively expensive diagnostic devices. Consequently, individuals with limited financial means may encounter challenges affording essential tests for the diagnosis and treatment of health issues [3]. A study reveals that non-elderly American adults with atherosclerotic cardiovascular disease (ASCVD) face medical bill-related financial hardship, affecting an estimated 3.9 million individuals (about twice the population of New Mexico) [5]. More than 45% of non-elderly adults with ASCVD report financial hardship linked to associated medical bills, with approximately one in five reporting an inability to pay the medical bills [5].

In addition to that, patients face the challenge of waiting for medical attention, Jesse Jacobs, a director in an innovation lab, shared her experience [8]. She highlighted that a mere 0.08% of her time at the hospital was devoted to receiving treatment for her condition. This revelation underscores a widespread issue where patients invest significant hours waiting in line to consult with a doctor, leading to a considerable waste of valuable time.

When it comes to pulmonary diseases, X-rays are crucial in diagnosing respiratory defects, but the cost of an X-ray can range from \$100 all the way up to \$20,000 or more [6]. Additionally, there are risks associated with X-rays, such as the chance of developing cancer, which is one in 2000 [7].

Moreover, individuals from rural areas encounter difficulties in accessing healthcare services, potentially jeopardizing their lives which could be saved otherwise. A notable 46 million rural inhabitants [4] are more likely to succumb to cancer, respiratory diseases, and cardiovascular illnesses in comparison to urban citizens.

In response to the escalating demand for innovative self-assessment solutions, our research aims to identify pulmonary and cardiac issues without reliance on traditional diagnostic tools such as X- Ray or ECG machines.

- [1] - https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1
- [2] - [https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-\(copd\)#:~:text=Chronic%20obstructive%20pulmonary%20disease%20\(COPD\)%20is%20the%20third%20leading%20cause,%2Dincome%20countries%20\(LMIC\).](https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)#:~:text=Chronic%20obstructive%20pulmonary%20disease%20(COPD)%20is%20the%20third%20leading%20cause,%2Dincome%20countries%20(LMIC).)
- [3] - <https://www.vox.com/science-and-health/2017/6/2/15712336/uninsured-minority-patients-overcharged-emergency-rooms-er>
- [4] - <https://www.bidmc.org/about-bidmc/news/2022/01/researchers-find-rural-patients-less-likely-to-receive-cardiovascular-care>
- [5] - <https://news.yale.edu/2019/02/11/nearly-half-adults-heart-disease-cant-afford-their-medical-bills>
- [6] - <https://www.healthline.com/health/mri-vs-xray#costs>
- [7] - <https://radiology.ucsf.edu/patient-care/patient-safety/radiation-safety/risks-of-radiation#:~:text=Weighing%20the%20Radiation%20Risks%20of%20CT%2C%20X%2Dray%20and%20Other%20Imaging&text=Very%20high%20doses%20of%20radiation,doses%20may%20also%20cause%20cancer.>
- [8] - <https://hbr.org/2017/05/health-care-providers-must-stop-wasting-patients-time>

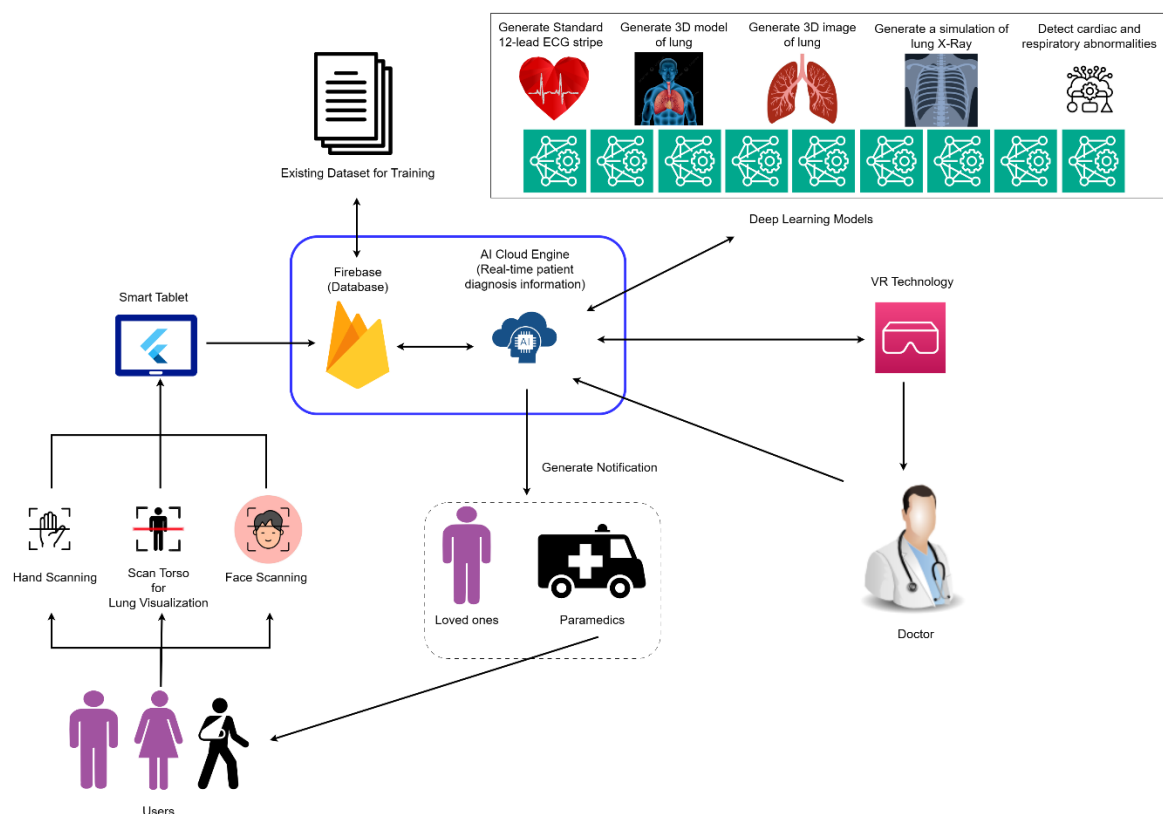
6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

This solution includes cutting-edge technologies such as Computer Vision (CV), Artificial Intelligence (AI), Deep Learning (DL), and Convolutional Neural Networks (CNN) to grant patients easy access to their cardiac and pulmonary vitals.

Users will be able to assess their cardiac health through our solution, the method utilizes dry electrodes to obtain a 12-lead Electrocardiogram (ECG) reading, the gold standard for such assessments. Additionally, a smart tablet camera and remote photoplethysmography (rPPG) allow users to assess cardiac health by observing facial blood volume changes, generating an ECG reading for disease diagnosis.

A virtual reality (VR) component enables doctors to view a 3D model of the patient's lungs, enhancing their understanding of the condition. The solution also incorporates a user-friendly mobile app for patients to track health data and receive notifications. An AI cloud engine, connected to a Firebase real-time database, powers deep learning models trained on existing datasets to identify ECG patterns and cardiac/respiratory abnormalities.

This easily accessible solution, requiring no specialized training, aims to improve patient care by providing comprehensive information for accurate diagnoses and effective treatment plans. The scalability of the design allows widespread adoption among both patients and doctors, offering potential benefits in managing cardiac and respiratory abnormalities, enhancing healthcare quality, and reducing complications.



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

- **Specialized domain expertise**
 - Expertise in the fields of medical imaging, computer vision, signal processing, cardiovascular, radiology and respiratory physiology.
 - Expertise of cardiologists, pulmonologists, and radiologist
- **Knowledge**
 - Knowledge on cardiac electrophysiology, vascular dynamics
- **Data requirements**
 - Datasets of facial images, X-Rays and Electrocardiogram readings of heart patients.

8. Objectives and Novelty

Main Objective Diagnosis of pulmonary and cardiac abnormalities of a patient with an invasive methodology which provides the feasibility for the patients to get the diagnosis by connecting to a doctor virtually. The research aims to provide a feasible and convenient method for patients to get their diagnosis by reducing the number of hospital visits.			
Member Name	Sub Objective	Tasks	Novelty
Vihansa S.A.S	Respiratory disease diagnosis via image processing of a lung X – Ray and Generating a 3D model based on the real time video feed.	<ul style="list-style-type: none"> • Training a model to differentiate unhealthy and healthy lungs. • Predict the abnormalities depicted in the lung via image processing and Convolutional Neural Network (CNN). • Generate 3D model image of lung x – ray obtained from the specialized camera. 	<ul style="list-style-type: none"> • Analyzing the size, shape, and abnormal tissues of lung x – ray with the use of algorithms. And predict respiratory abnormalities such as atelectasis, consolidation, cardiomegal, mediastinal widening, pneumoperitoneum, pneumothorax, pulmonary edema, pulmonary lesion, emphysema, and pleural effusion.

			<ul style="list-style-type: none"> Facilitate real-time 3D view of lungs with the help of 2D images which aid in facilitating immediate diagnosis and monitoring of conditions.
Senadheera P.V.P.P	Identification of cardiac rhythm through the analysis of palms.	<ul style="list-style-type: none"> Scanning palms using dry electrodes. Process Lead I, II and III ECG patterns. Obtain Lead aVL, aVR and aVF using Goldberger's equations. Obtain chest leads ECG patterns. 	<ul style="list-style-type: none"> Generate a 12-lead ECG pattern by analyzing the palms using dry electrodes.
Wijeratne D.M.S.D	Identification of Cardiac rhythm and Cardiac disease diagnosis through facial analysis	<ul style="list-style-type: none"> Use remote photoplethysmography to obtain facial data. Generate single lead ECG from facial data. 	<ul style="list-style-type: none"> Contactless monitoring of heart abnormalities through a tablet camera by analyzing the face and obtaining a 12-lead ECG for early detection and

		<ul style="list-style-type: none"> • Use single lead to generate all 12 Leads of ECG. • Use ECG readings to diagnose cardiac diseases. 	prevention of cardiac diseases.
Christy H.M	Generation of a 3D lung image via the aid of the simulated X-ray image generated.	<ul style="list-style-type: none"> • Segmentation of layers of the chest image captured via the camera. • Extract the bone information and other related segments of material from the image captured. • Apply deep based shading to the image following the extraction of details as mentioned above. 	<ul style="list-style-type: none"> • Generation of a 3D image of the lung, that accommodates the facility of a quick and precise diagnosis of respiratory diseases. • Discovering a methodology to get an x-ray of the lungs with the help of a device camera, thereby eliminating the potential exposure to radiation that a patient may have to confront.

		<ul style="list-style-type: none">• Train a model with existing chest X-rays and construct a 3D image with the use of Deep Neural Network.	
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9. Supervisor checklist

- a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes	<input checked="" type="checkbox"/>	No	
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- b) Does the proposed topic exhibit novelty?

Yes	<input checked="" type="checkbox"/>	No	
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- c) Do you believe they have the capability to successfully execute the proposed project?

Yes	<input checked="" type="checkbox"/>	No	
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- d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes	<input checked="" type="checkbox"/>	No	
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- e) Supervisor's Evaluation and Recommendation for the Research topic:

This is a timely AI health Project that has the scope of penetrating the global health market. The timely case studies have continuously proven the need for a self-diagnosing Tele-Health type innovation to reduce and Cardiac and Respiratory related abnormalities faced by the modern man. I believe that this team also has the potential to present this project to a series of national and international competitions which in return will highlight SLIIT at a prestigious level.

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Dr.	Dilshan	De Silva	
Co-Supervisor				
External Supervisor	Mr	Pramadhi	Atapattu	
Summary of external supervisor's (if any) experience and expertise				

**This part is to be filled by the Topic
Screening Panel members.**

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

***Important:**

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and request the RP Team for a new topic assessment.
3. The form approved by the panel must be attached to the **Project Charter Form**.