Affiliation: FAST-NUCES KARACHI Pakistan			
Department: Computer Science		**Specialization:** Computer Vision, Machine Learning, Artificial Intelligence **Domain** Applied Research	
Proposal Title: Dil Ki Dharkan: An AI-Driven Self-Aware approach to detect early onset Heart Attacks.			
Required Budget **US dollars** 39747	**Proposed Duration (Max months)** 12 Months	**Desired Starting Date** 1st October 2023	
Name of the Investigator(s) (Full Name)	**Academic Title**	**Investigator's Affiliation (Dept. / College)**	**Nationality**
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Abstract

As stress, cholesterol, diet-related issues, and smoking among middle-aged generations become increasingly prevalent, signs of early onset heart attacks are progressively becoming more and more alarming. Health monitoring devices like smartwatches and fitness bands (through the use of Internet of Things (IoT)) can play a pivotal point in preventive health care measurements and early intervention. Through the use of AI-driven health monitoring systems, individuals can actively track their cardiac health and detect early signs or symptoms of a potential heart attack. Real-time monitoring of vital parameters, such as respiratory and heart rate, blood pressure, oxygen saturation levels, ECG readings and glucose (sugar) readings, enables users to identify any abnormalities or irregular patterns, prompting them to seek immediate medical attention before a full-blown cardiac event occurs.

Through the use of this technology, we aim to develop an autonomous self-aware system which can detect anomalies and irregularities through continuous monitoring and data analysis to detect potential red flags prompting the user about their well-being and consult medical authorities and physicians.

As widespread and extensive heart attacks keep occurring at younger ages, early detection is paramount to curbing this concerning trend. Embracing AI-driven health monitoring devices as a proactive tool for cardiac care offers a transformative solution in safeguarding the future of the younger generation, promoting healthier living, and ultimately saving lives.

Keywords: Artificial Intelligence, Heart Attacks, IoT, Medical, Risk Assessment, Deep Learning.

1. Introduction

Advancements in networking systems have given rise to significant developments in the field of Information and Communication Technology (ICT) in recent years. The ease in availability of various services and applications on smartphones reveal just a single perk of growth in the ICT field.

The Internet of Things (IoT) can be defined as an intricate ecosystem of interconnected physical entities, such as devices, appliances, sensors, actuators, and machines, that are endowed with embedded computing systems and possess the ability to communicate, share data, and cooperate with other entities within the network autonomously or semi-autonomously, without direct human intervention [1]. These "smart" objects leverage various communication protocols, including but not limited to Wi-Fi, Bluetooth, and cellular networks, to collect and transmit data, enabling them to interact with their environment and respond to real-world events. IoT helps facilitate intelligent decision-making, automation, and enhanced efficiency across a multitude of domains, thus effectively bridging the gap between the digital and physical worlds.

Aside from revolutionizing many fields such as transport, healthcare, education, and tourism, it has constructively been able to contribute to the growth of a country's economy, if utilized properly. We can perceive IoT as a future technology due to its numerous advantages and benefits.

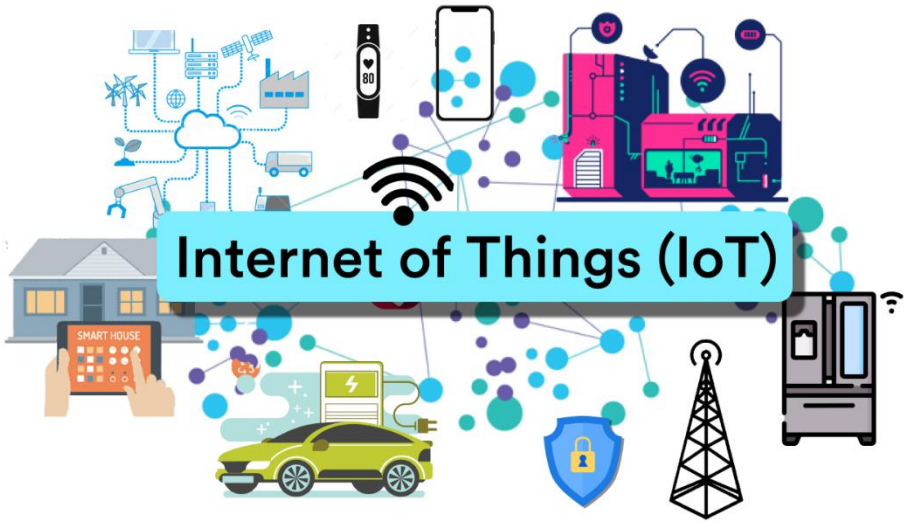

Fig.01: Various components encompassed by IoT

Figure 1 gives an idea of the increasing relevance of IoT in our everyday lives. In this research project, we aim to take advantage of the increasingly common nature of IoT devices such as smartphones and smartwatches, to propose a self-aware medical monitoring system that is capable of detecting early-onset heart attacks by taking multiple sensor readings from the smart devices in the network, and leveraging deep learning models to ascertain whether the indication of a heart attack is being detected due to any external factors, or due to a real heart attack.

The main novelty of our proposed system lies in its 'self-aware' nature, which allows it to be situationally aware of its surroundings and establish probable cause for any abnormal sensor readings that may be detected by the devices.

2. Problem Statement

According to the World Health Organization (WHO) cardiovascular diseases (CVDs) stand as the primary global cause of mortality, claiming approximately 17.9 million lives annually representing 32% of all global deaths. Of these deaths, 85% were due to heart attack and stroke. Over 80% of CVD-related deaths are attributed to heart attacks and strokes, with one-third of these fatalities occurring prematurely in individuals below 70 years old.

This issue seems especially widespread amongst Pakistani victims. According to WHO data from 2016, about 250,000 people died each year in Pakistan due to heart diseases, accounting for 19% of all deaths. However, in only three years, the WHO has found a 29 percent increase in total deaths related to heart diseases in Pakistan, totaling around 406,870 each year.

As stress, cholesterol, diet-related issues, and smoking among middle-aged generations become increasingly alarming, signs of early onset heart attacks are progressively becoming more and more evident. Continuous monitoring and data analysis to detect potential red flags prompting the user about their well-being and consulting medical authorities and/or physicians can play an integral role in curbing the distressing trend.

3. Literature Review

Our main concern lies in early diagnosis of cardiovascular diseases, arguing whether AI can be used in accurate identification of risk factors [2] while monitoring patients for signs of cardiovascular health deterioration and to predict future cardiac events. Similarly, real-time monitoring is of equal importance in identifying early abnormalities or irregular patterns indicating a cardiac event [3], allowing patients to seek immediate attention and implement preventative measures.

One such approach is known as Preserved Ejection Fraction (HFpEF), a technique which utilizes electrocardiography (ECG) to detect early onset heart failure. Trained on patients with and without HFpEF, a proposed AI algorithm was able to achieve an accuracy of 86.6% in precise detection of HFpEF [4].

AI, implemented precisely, can help identify the leading cause of cardiac events before they occur, being able to identify risk factors for diseases and monitor patients for signs of disease progression, and ultimately predicting the risk of future events [5]. Contextually aware AI-powered medical devices were proposed for this very reason [6]. Different types of information processed by these AI-powered medical devices can alleviate the impedance caused by cardiovascular events or "context" which can prove to be an essential steppingstone for accurate and reliable predictions [7]. Furthermore, along with being reliable, contextually aware AI systems can be used to personalize the treatment for a specific patient [8].

Previous works conducted by various researchers motivate and construct a foundation for our framework accompanied by the outcome we hope to achieve. Powered by interconnected IoT smart devices such as smartwatches and smartphones, that utilize cloud based vital data storage, allow us implement intricate deep learning models to detect the presence of heart attacks, and consequently take the necessary measures. The novice lies in the self-aware nature of the model. Self-aware systems can learn the normal situation in an incremental step-by-step process and capture abnormalities at each stage by observing the data values deviate from normal ranges.

4. Description (Rationale) Of the Proposed Work

In our proposed work, our goal is to establish an IoT-powered system that can periodically take sensor readings from the devices equipped by the user, perform the necessary sensor fusion from multiple sources such as heart rate, ECG, blood pressure etc., and then utilize machine learning methods to determine the extent of a risk of heart attack as a warning scale indicator. The primary aim of the system is to be situationally aware of the context that the sensor readings are being taken in and take that context into account. For example, a user that is running or jogging will naturally experience an elevated heart rate. While monitoring systems that are not contextually aware may consider this a sign of an incoming heart attack, our self-aware system will be able to decide that these readings are the result of the user's exercise and are not to be considered alarming [9].

However, in the event that the readings found by the sensors are indeed determined to be abnormal by the deep learning models, despite taking contextual cues under consideration, the system will then enter an early warning state, which may involve a number of preventative measures to allow the potential heart attack victim to seek help and medical attention.

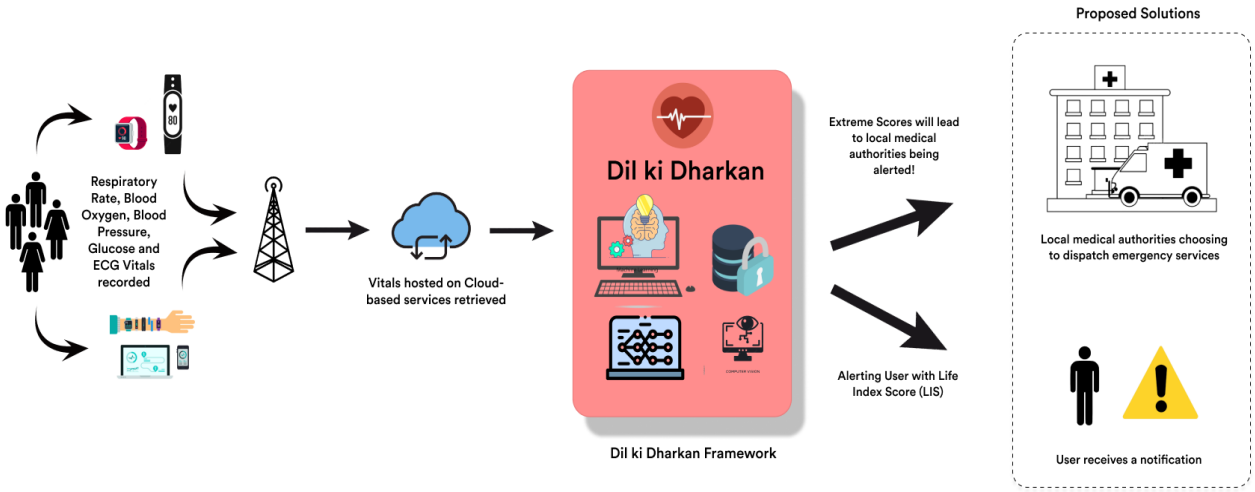

Fig.02: The considered scenario for intended work

The brief fundamental working that we aim for can be viewed in the illustration provided in figure 02. It indicates a simple flow of medical health monitoring devices and how

they connect into the network of various other devices, creating an ecosystem, after which Dil ki Dharkan plays an integral part in monitoring the vitals and detecting likelihood of acute cardiac diseases occurring.

5. Research Methodology and Design

The AI-driven health-monitoring devices will leverage the latest cutting-edge technologies including advanced AI algorithms, machine learning, computer vision and IoT integration. The system will utilize real-time data acquisitions from vital parameters and use cloud computing capabilities to facilitate storage, analysis and more. Additionally in the near future, the product will employ secure communication protocols to ensure data integrity during transmission.

The project will consist of the following phases:

5.1 Phase 1: Comprehensive research on health-monitoring device systems

The task involves conducting an extensive literature survey on previously developed self-aware systems with a similar architecture. The goal is to identify weaknesses in these systems and propose improvements by incorporating different models and approaches.

5.2 Phase 2: Data Collection

The objective is to synthesize data pertaining to respiratory and heart rate, oxygen saturation levels, ECG readings, and glucose sugar levels, with the intent to create simulated readings representative of diverse situational scenarios and influenced by specific patient histories.

By amalgamating these vital parameters, the aim is to generate comprehensive and dynamic datasets that could mirror real-world physiological responses, enabling the development and testing of novel medical technologies and predictive models in a controlled and ethically sound environment.

5.3 Phase 3: Feature Extraction.

Detecting early onset heart attacks is crucial for timely intervention and potentially life-saving measures. Extracting relevant features from ECG and vital signs can provide valuable insights for this purpose. Here are some key features that can aid in the early detection of heart attacks.

ECG Features: Electrocardiogram (ECG) is a fundamental tool for heart health assessment. Some significant ECG features (See figure 04) that can indicate the early onset of a heart attack include:

- ST-Segment Changes: Abnormalities in the ST segment can indicate myocardial ischemia, which is a critical warning sign of a heart attack [10].
- T-Wave Morphology: Changes in the T-wave shape and amplitude can also be indicative of myocardial injury and ischemia [11].
- QRS Complex: Alterations in the QRS complex duration can suggest conduction abnormalities, such as bundle branch blocks, which may be linked to cardiac issues [12].

Vital Signs Features:

- Blood Oxygen Levels (SpO2): A significant drop in oxygen saturation may signal poor cardiac output and reduced perfusion to vital organs, including the heart [13].
- Glucose Levels: Elevated blood glucose levels can be associated with insulin resistance and metabolic syndrome, contributing to the risk of heart disease [14].
- Blood Pressure: Sudden and severe changes in blood pressure, such as hypertensive crises, can be associated with an increased risk of heart attack [15].
- Respiratory Rate: An elevated respiratory rate may indicate respiratory distress, which can affect oxygen supply to the heart and lead to cardiac strain [16].
- Heart Rate: A measure of how many times a heartbeat has occurred per a specific standard of time, inflated or drastically low rates compared to constants set of an individual can prove alarming.

By integrating these extracted features and analyzing them collectively, automated self- aware systems can better assess an individual's cardiovascular health and promptly identify potential early warning signs of a heart attack.

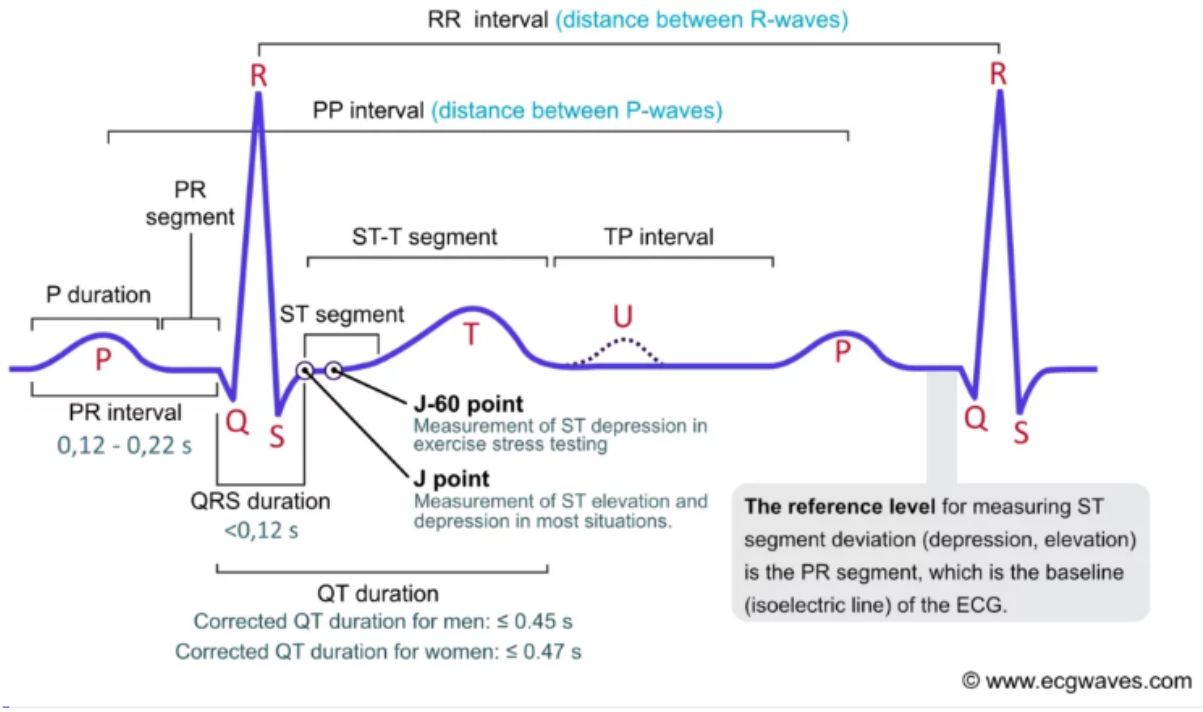

Fig.04: ECG Wave and its features [17]

5.4 Phase 4: Create the model and implement the features.

This investigation focuses on situational awareness effects on vital signs and the model's ability to distinguish true values from interfered ones. By analyzing different scenarios and incorporating patient history, including ECG readings, the study aims to provide valuable insights for better healthcare decision-making.

5.5 Phase 5: Model Tuning

To create a robust and well-generalized model, the training process will incorporate a variety of deep learning algorithms to mitigate the issues of overfitting and underfitting. By employing multiple algorithms, the model can benefit from the diverse strengths and regularization techniques each one offers.

Conducting multiple training iterations will allow for fine-tuning the model's parameters, architecture, and hyperparameters to achieve a well-optimized and balanced model that can effectively handle diverse data scenarios and perform accurately on unseen data. Regular evaluation on validation datasets will guide the training process, ensuring that the model achieves high performance and generalizes well to real-world situations.

Through our current research we aim to integrate different models for each respective stage and determine which model works best for each phase. Although the current shortlisted algorithms we have considered to include LSTM, Decision Tree, or Random Forest classifiers and SVM, we aim to configure models based on how accurate they tend to perform on respective stages of the process rather than determining immediately before testing.

5.6 Phase 6: Evaluation

After training the model, the next critical steps involve validating and testing its performance. The validation process aims to assess the model's capability to generalize well on data it has not seen during training. This is typically achieved by using a separate validation dataset, distinct from the training dataset. The model's accuracy, precision, and other relevant metrics will be evaluated using a confusion matrix, which provides a comprehensive overview of true positive, true negative, false positive, and false negative predictions.

The accuracy and precision metrics obtained from the confusion matrix will provide valuable insights into the model's overall performance and its ability to correctly classify data into different categories. By understanding the strengths and weaknesses of the model, further fine-tuning and optimization can be carried out to achieve a well-performing and reliable model, capable of handling real-world data and providing accurate predictions in diverse situations. Continuous evaluation and improvement will be conducted until the desired performance levels are achieved.

6. Research Objectives and Expected Outcomes

The system revolves heavily around taking the users vitals that are most important at determining early onset heart attack, such as Respiratory rate, Oxygen Saturation level, Electrocardiogram (ECG) ratings, Heart rate and Glucose (sugar) levels as input and passing them through a series of functional stages before producing an early warning score (EWS) indicating the likelihood of suffering from acute cardiac events in the near future as visually illustrated in figure 03.

1. Initially, the system will detect changes in the user’s physical activity - Is the person sitting down, standing up, walking, running, or sleeping etc., thus eliminating the external human factors which could be interfering with the user’s vitals.

2. Secondly, we move on to cardiovascular risk assessment and health heart monitoring, where we will use patient's history provided by users to determine the impact on irregularities detected in vitals, also taking into considerations the environmental factors may leave on the vital readings.
3. Next, we move onto ECG analysis where user, if determined as an extreme case, can provide ECG results (during initial phase) conducted from local laboratories for examination as opposed to consulting expensive physicians.
4. The AI-driven system will be able to rank the user's health (EWS) based on how likely he/she may be to suffer a heart attack in the near future.
5. Lastly, as a preventive measure, the system should also be able to trigger emergency responses to medical authorities in the vicinity in extreme last-minute cases.

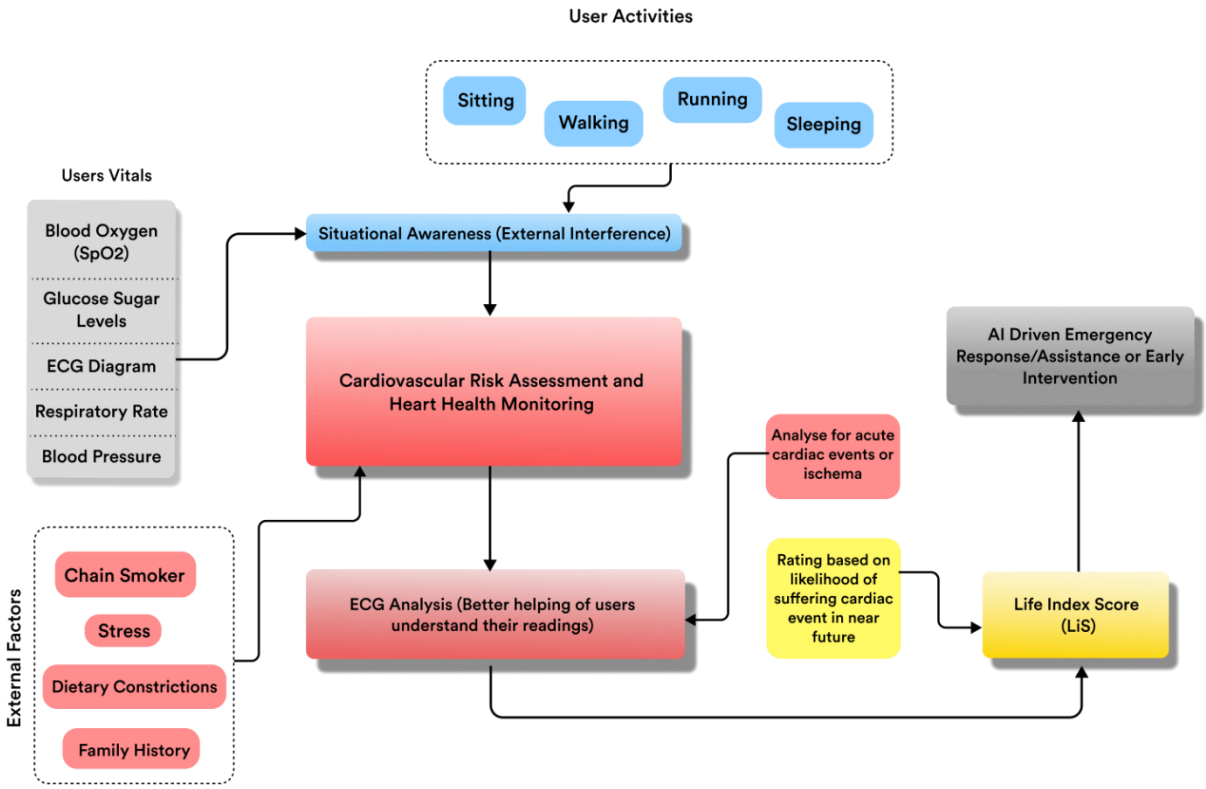

Fig.03: Elaborated run-down of Dil ki Dharkan's various stages and phases

Tables 6.1 and 6.2 map the objectives, approaches, phases, and the tasks carried out to implement the objectives.

Table 6.1 OBJECTIVES AND THEIR APPROACH MAPPING

Objective	Approach for achieving the objective
1	Building a self-aware AI-driven model able to accurately score a warning based on a person's vital readings.
2	Test the effects of change in a person's activity (situational awareness) and whether the system is able to determine change in vital readings is in due part.
3	Apply patient history and other cardiovascular risk assessment analysis and determine if it increases or decreases the chances of suffering (Possibly a DT problem to indicate how patient history impacts the vital readings).
4	Create an ECG Analysis classification model to effectively combat the process of validating reports by consulting expensive physicians and medical authorities.
5	Rank the patients' health in a score-based scale to better facilitate the user in understanding the seriousness of his/her health.
6	Applying synthesized dataset to train the model.
7	Validate and test the model using validate and test sets.
8	Perform evaluation using accuracy and precision of the system

Table 6.2 OBJECTIVE PHASES AND TASKS MAPPING

Objectives	Phases	Tasks
1	Comprehensive research on health-monitoring device systems	Perform a comprehensive literature survey on self-aware systems previously developed on a similar architecture. Identify their weaknesses and build them on top using different models for suppose.
2	Data Collection	Synthesize respiratory rate, oxygen saturation levels, ECG readings and glucose sugar levels to potentially mimic the readings in different situational scenarios and influenced by patient history.
3, 4 & 5	Create the model and implement the features	Start by assessing effects of situational awareness and how it impacts the vitals but more importantly whether the model can distinguish between interfered vitals and true values.

		Then, introduce cardiovascular risk assessing factors using patient history to better analyze the impact on the vital signs and as last resort or to assure conformation, we analyze ECG readings and help users better understand what laboratory reports mean.
3, 4 & 5	Model Tuning	Train the model using various deep learning algorithms to prevent issues of overfitting and underfitting. Conduct multiple training iterations to ensure a well-optimized and balanced model.
7 & 8	Evaluation	Validate and test the model, evaluate, if any shortcomings and work towards resolving them. Analyze accuracy, precision through confusion matrix.

7. Scope and Limitations

The AI-driven health monitoring device holds immense commercial potential due to the transformative effects it can have on reducing the increasingly alarming rate at which heart attacks seem to occur in the middle aged and younger generations [18]. As the prevailing risk of cardiac arrest continues, we need innovative AI-driven solutions which empower individuals to assess their lifestyles and heart health [19].

With our main focus on prevention and detection, Dil ki Dharkan aims to draw significant attention to itself in the healthcare industry as awareness grows. Similarly, the demand for self-aware health monitoring devices can be projected to rise steadily due to their capabilities and seamless integration with IoT technology targeted at health-conscious consumers. We can expect considerable demand from local medical centers and insurance providers as the anticipated organizations initially.

Our aim is to push the commercial potential by addressing the growing concerns of early onset heart attack victims. With an anticipated rise in demand in local, regional, and international markets, the product's self-awareness capabilities and integration with IoT set it apart in the healthcare industry by strengthen its position as a transformative solution in preventive cardiac care, with the potential to save lives and improve overall well-being.

However, the limitations in the current state of our project revolve heavily around gathering real-time patient data, which includes patient history, their vitals and their ECG graphs from major smartwatch and fitness band manufacturers for various privacy concerns or breaches. This is precisely why Dil Ki Dharkan is a service that most industry leading manufacturers can opt for, providing an additional service on top of their pre-existing fitness modules.

8. Management, Working Plans and Timeline

8.1 Management Plan, Research Team, Roles, and Tasks

The following research is aimed to project 12 months of involvement of all two UG students working on the project under the administration of the supervisor, with help from various graduate parties and MS students.

The progress reports will be timely submitted upon request(s) and brief summary reports or meetings with the supervisor will be conducted to ensure set objectives are being met within the timeline decided prior to starting.

Under the guidance and overseeing of the supervisor, the project and its members will aim to present it in as many local, national and international cohorts and competitions as expected. The full research paper concluding our research and findings will be presented in the final report presented at the very end as appendices of the report.

Table 8.1 and 8.2 introduce and details the research team, their roles, tasks carried out by the team members and their timelines.

Table 8.1 ROLE AND INVOLVEMENT DURATION OF RESEARCH TEAM

Team Members	**Role**	**Duration** (months)
Senior Personnel:	We intend to carry out this project as a research group, in which each member is expected to be involved in literature review, model/tool building and testing, write-up	12
Dr.Muhammad Farrukh Shahid (MFS)	Dr. Muhammad Farrukh Shahid is a Principal Investigator who will be responsible for overall research project, both in the management of its activities and tasks as well as ensuring the consistency of how its various scientific parts (IoT and machine learning aspects) fit together. He will specifically be responsible for ensuring overseeing that the project is valid according to the scientific principles of the context so that our deep-learning models are properly contextualized.	12

Rayyan Minhaj (20K-0143) - RM	As an undergraduate student, Mr. Rayyan Minhaj will actively be participating throughout the phases and will be dealt equal responsibilities as the other members in dutiful literature review, data analysis, model building and documentation under the supervision of Dr, Muhammad Farrukh Shahid.	12
Ayaan Danish (20K-0245) - AD	As a college undergraduate, Mr. Ayaan Danish aims to make meaningful contributions to the realization of the project by providing his expertise in matters of technical documentation, research, AI programming, model tuning, and data manipulation. All additional responsibilities and contributions will be made as needed and governed by Dr. Farrukh Shahid.	12
Zorays Asif (20I-1820) -ZA	Mr. Zorays Asif will actively be contributing throughout the phases and will be dealt equal responsibilities as the other members in articulating different aspects and modules of the project under the supervision of Dr, Muhammad Farrukh Shahid.	

Table 8.2 PROJECT TIMELINE MAPPED WITH THE TEAM ROLES AND PHASES

Phases	Participants and Involvements	1	2	3	4	5	6	7	8	9	10	11	12
1	MFS, RM, AD, ZA												
2	MFS, RM, AD, ZA												
3	MFS, RM, AD, ZA												
4	MFS, RM, AD, ZA												
5	MFS, RM, AD, ZA												
6	MFS, RM, AD, ZA												

8.2 Project Outcomes and deliverables

In conclusion, we intend to apply state-of-the art technologies that adhere to industry leading standards and regulatory requirements. With positive end-user feedback, a user-friendly external packaging, and comprehensive documentation, the AI-driven health monitoring

device will be able to stands as a solution in early interventive healthcare, empowering individuals, and medical professionals alike. The expected outcomes are as follows:

1. AI-driven self-aware model for abnormality detection vitals that warn towards early onset heart attack.
2. Accurately identify irregularities in ECG and provide a brief explanation on early intervention if needed,

Table 8.3 maps the project outcomes with the strategic technology goals.

Table 8.3 RELATIONSHIP TO STRATEGIC FRAMEWORK

PROJECT EXPECTED OUTCOMES	**STRATEGIC TECHNOLOGY PROGRAM GOALS**			**PROJECT OBJECTIVE ACHIEVED**
	GOAL 1 Advances in AI/Deep learning research	**GOAL 2** ECG Analysis	**GOAL3** Developing Self-aware system	
1 (Original research)	√			7 & 8
2 (AI-driven Self-Aware model)		√	√	1, 3, 5 & 6
3 (Accurate ECG identification)		√	√	2 & 4

9. Utilization

- As the system aims to be integrated seamlessly with existing IoT applications through medical health-monitoring devices, we can progress the scalability to rise with the addition of users in the system protected through secure layer over the network to ensure patient data confidentiality.
- Produce a transformative solution in preventive cardiac care, with the potential to save lives and improve overall well-being.
- Targeted persons, accustomed to devices similar to smart fitness bands, smartwatches and various other health monitoring devices will be met with smooth incorporation in the system.
- Will be able to provide an innovative AI-driven solution which empower individuals to assess their lifestyles and heart health.
- Establish an autonomous self-aware system that utilizes diverse machine learning algorithms and computer vision techniques to continuously analyze data, identifying potential red flags in an individual's well-being.

10. Curriculum Vitae (of each research team member)

The CVs of all team members are included in a separate file.

11. Project Budget

Table 11.1 shows the estimated proposed budget and justifications of the project. The budget is divided into 3 teams, equipment fee and miscellaneous costs.

Table 11.1 PROPOSED BUDGET

SUMMARY
PROPOSED BUDGET

Dollars ($)

PROJECT TITLE		Dil Ki Dharkan: An AI approach to detect early onset Heart Attacks.						
DURATION		**(12) MONTHS**						
ITEM	**CATEGORY**	**NO.**	**COMPENSATION**	**FIRST HALF**		**SECOND HALF**		**TOTAL**
				MONTHS	**BUDGET**	**MONTHS**	**BUDGET**	
A-Research Team	**CONSULTANTS**	**1**	**300**	**2**		4		1800
	PRINCIPAL INVESTIGATOR							
	CO-INVESTIGATOR-2							
						TOTAL-A		**1800**
B-	**PHD STUDENTS**							

Assistants	**MS STUDENTS**	**1**	350	4		4		2800
	UNDERGRADUATE STUDENTS	**3**	200	4		4		6400
	TECHNICIANS	1	120	4				480
	SECRETARIAL- CLERICAL							
	OTHER (programmers and developers)	**1**	**200**	**6**		6		2400
						TOTAL-B		**12,080**
C- Computer Services & Consultants	**Computer Service** (Connection and telecommnication costs)		**4000**	Internet connection and communicatin needs				4000
	CONSULTANT	1	2000					2000

	Consultant Services							
						TOTAL-C		**6000**
D- EQUIP. & MATERIAL	**MAJOR EQUIPMENTS (< = 100.000)**							
	EQUIPMENTS Major (> 100,000) Laptop/Mac, 2 Tensor GPU and CPU for Deep Learning (M2 Mac Studio 32GB RAM 512 GB SSD)			**16387**		To train deep learning algorithm, Bayesian Network and design UI		16387
	EQUIPMENTS Minor (> 10,000) Sensors, sensor modules, smartwatches, ECG machine, AWS cloud solutions 4 sensors for data collection and AWS services for deployment. Smartwatches for real world testing			**2800**		Different sensors to collect data for model training and AWS services needed to deploy model, smartwatches to test model in real world		2800
	CONFERENCES			**3x200**				600
	PATENT REGISTRATION							
	PUBLICATIONS			**1x80**				80

	WORKSHOP	-		
	OTHER EXPENSES			
ITEM TOTAL				**19867**
GRAND TOTAL				

A. SALARIES (Research Team)	**4.53%**	**1800**
B. SALARIES (Assistants)	**30.4%**	**12080**
C. Computer Services & Consultants	**15.1%**	**6000**
D. EQUIP. & MATERIAL	**49.98%**	**19867**
GRAND TOTAL	**100 %**	**39,747**

12. Conclusion

The novelty and uniqueness of our proposed framework lies in its capacity to be self-aware, i.e., aware of the current context that the user is in (out on a jog or sleeping perhaps). This essentially allows our system to judge whether any abnormal vital readings are simply being detected as a result of various physical activities, rather than a real emergency situation. The self-aware aspect of our system is something that we believe hasn't been explored and exploited to its fullest extent before, and that is exactly the sort of paradigm shift that we aim to bring about with our project. This heightened self-awareness empowers users to promptly seek medical attention long before a full-fledged cardiac event occurs.

The integration of AI-driven health monitoring devices with IoT technology marks a groundbreaking advancement in early onset heart attack detection and preventive healthcare. With the alarming rise in cardiac risks observed among middle-aged individuals, this transformative solution holds the promise of reversing the trend and building a healthier, more resilient future. By empowering individuals to actively manage their cardiac health and facilitating timely interventions, we pave the way for a generation better equipped to tackle cardiovascular challenges and lead fulfilling lives.

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