Enhanced Virtual First Aid Box to Prevent and Rescue in Body Health Using Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) Algorithm

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***Abstract*-. This study is focus to Enhanced Virtual First Aid Box (EVFAB) leverages advanced technologies to provide health monitoring and preventive measures, integrating the Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) algorithm for robust and adaptive solutions. EG-MAML enables the system to rapidly learn from minimal data, optimizing medical decision-making and preventive actions in dynamic health scenarios. The model integrates genetic algorithms with deep learning to enhance the adaptability of first aid protocols, tailoring responses to individual health conditions and real-time physiological data. This innovation not only aids in timely interventions during emergencies but also proactively identifies potential health risks, ensuring early detection and personalized prevention strategies. By utilizing an intelligent system like EG-MAML, the virtual first aid box becomes a versatile tool, contributing to public health resilience and improving individual well-being through cutting-edge machine learning techniques.**

Keywords; Body Health, Deep Extreme Genetic Model-Agnostic Meta-Learning Algorithm, Prevent and Rescue

I. Introduction

In the digital era, healthcare technology continues to evolve, enhancing the capacity to monitor, prevent, and respond to health emergencies. One such innovation is the Enhanced Virtual First Aid Box (EVFAB), a cutting-edge system designed to revolutionize personal health management. Traditional first aid kits are limited to physical tools and supplies, providing immediate yet basic care during emergencies. While they are essential, their scope remains restricted to passive medical aid, relying on the knowledge and preparedness of individuals [1]. With the integration of artificial intelligence (AI) and machine learning (ML) algorithms, the concept of a first aid box has taken a significant leap forward, offering proactive and intelligent solutions that adapt to real-time health conditions [2]. This paper explores the development of EVFAB using the Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) algorithm, a powerful approach that enables real-time health prevention and rescue.

EVFAB represents a shift from reactive to preventive healthcare, offering personalized health monitoring and guidance [3]. By utilizing sensors, data analytics, and AI-driven decision-making, the virtual first aid box can detect physiological anomalies, predict potential health risks, and recommend preventive measures before an emergency arises [4,5]. Furthermore, in critical situations, EVFAB provides immediate, customized instructions tailored to the individual's health condition, significantly improving response time and accuracy [6]. The core of this system lies in the EG-MAML algorithm, which allows the model to adapt quickly to new health data, making it a versatile tool for a wide range of users and medical conditions [7,8].

The EG-MAML algorithm is a hybrid approach that combines deep extreme learning machine with genetic algorithms, and model-agnostic meta-learning [9,10]. Deep learning provides the system with the ability to analyze complex, high-dimensional data such as heart rate, oxygen levels, and other physiological signals [11]. Genetic algorithms introduce optimization techniques that evolve the model over time, enhancing its ability to make precise predictions and recommendations [12]. Model-agnostic meta-learning (MAML), a framework designed to enable quick learning from limited data, is crucial for real-time health applications, where data may be sparse or unpredictable [13,14]. By combining these elements, EG-MAML empowers EVFAB with the capability to generalize across diverse health scenarios and user profiles, while continuously improving its performance based on new data [15]. The integration of EG-MAML in the EVFAB system offers several key advantages. First, it ensures that the first aid box is not merely a passive tool but an intelligent, dynamic system that evolves with the user's health needs [16]. For example, if the system detects recurring patterns in a user's health data, it can adjust its predictions and preventive measures accordingly [17]. Second, the EG-MAML algorithm allows the system to learn quickly from minimal data, making it especially useful in urgent situations where time is critical, and large datasets are unavailable [18,19]. The Enhanced Virtual First Aid Box, powered by the EG-MAML algorithm, represents a significant advancement in personal healthcare technology, from pre-emergency response to proactive prevention especially at home and in general when traveling outside the home.

II. METHODS

Virtual First Aid Box

Virtual First Aid Box in the cloud based on Fig. 1 is a digital solution that integrates advanced technologies to provide quick and easy access to first aid information utilize AI [20][21].

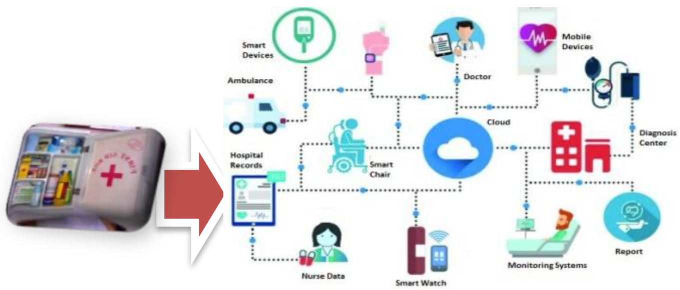


Figure 1. Ilustration of First Aid Box to Virtualization (Pre-Hospital Emergency) [22–24]

As an prototype open microservice development for hospitals in Indonesia based on API, the system can also be integrated with real-time patient health data [25]. With AI features that offer recommendations tailored to the user's condition, the Virtual First Aid Box can support faster and more accurate emergency care [26][27]. The Virtualization of FAB like a IoT technology that connected to health devices enables the system to provide early diagnoses or alert users to signs of danger [28]. The use of API ensures that this system is flexible and can be integrated with various healthcare services in hospitals to support more responsive emergency care [29].

Body Health in the Green Technology of Islamic Medicine

Body health based on Fig. 2 using the intelligence system of VFAB to assist users in handling health emergencies by offering step-by-step instructions accessible as data information of human body [30]. The information provided covers how to manage wounds, injuries, and emergency actions such as heart rate suddenly beats fast after eating certain foods (heart palpitations) that may your body have food allergies or sensitivities so can trigger them.

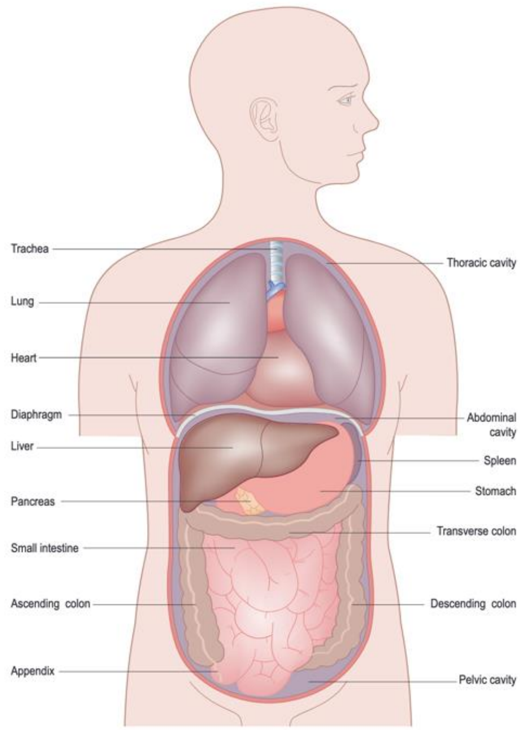


Figure 2. Human Anatomy [31]

The paradigm of *the green technology of Islamic medicine* is not merely a traditional approach; it represents a comprehensive health management approach that remains highly relevant in the context of both modern and postmodern developments, which can be studied through the Quran and Hadith. The following points emphasize the importance of health preservation through dietary practices and their implementation as part of the *green technology of Islamic medicine* framework.

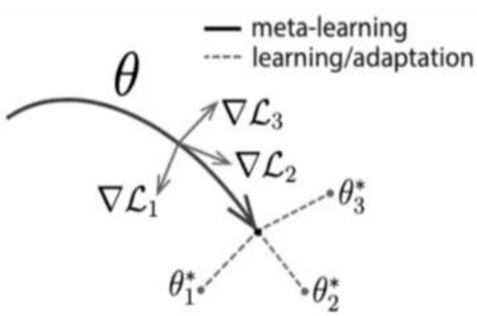
- The urgency and importance of choosing halal, wholesome, and healthy food are based on Surah Al-Baqarah, verses 168-169 [32], which emphasizes consuming what is lawful and good, and on Surah Al-A'raf, verse 31, which advises eating and drinking without excess.
  - Select types of food and drink that are halal, wholesome, and healthy, such as those verified through halal blockchain, natural, fresh, and not overly cooked. This type of food, *Insha'Allah*, promotes better health and acts as a preventive measure, akin to medicine, as prevention (pre-emergency care) is better than cure.
  - Moderation: Individual preferences may vary based on personal experience and conditions.
- Every Muslim is also permitted to seek medical treatment, as per Hadith [33], since every illness has a cure.

- Treatment options can include visits to medical laboratories, hospitals (general practitioners or specialists), clinics, and equivalent health institutions for consultations. Muslims can request referrals for blood tests, Mean Arterial Pressure (MAP) checks, Caesarean sections, endoscopies, colonoscopies, vaccinations, or other advanced technology procedures.
- Moderation: Adjust treatments according to recommended dosage preferences, as individual needs may vary depending on specific circumstances.

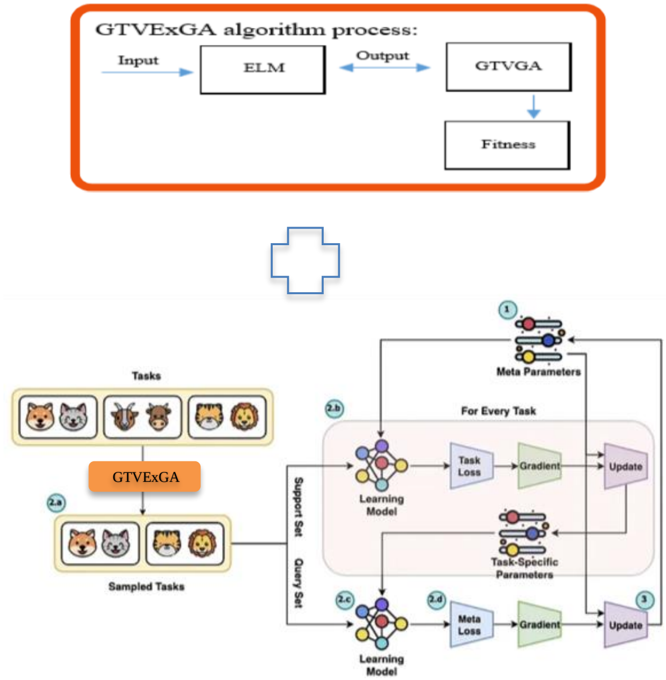
Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) Algorithm

The Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) method is introduced as an innovative approach that merges meta-learning techniques with genetic algorithm-based optimization to improve a model's capacity to learn effectively from limited data. The primary aim is to enable models to adapt to new tasks more swiftly. EG-MAML also incorporates the concept of Extreme Genetics by combining the Extreme Learning Machine (ELM) algorithm with a genetic algorithm (GA) based on Geometric Time Variants (GTV) [34]. This integration promotes a well-balanced, efficient process of exploring and exploiting across generations.

Require: $p(\mathcal{T})$: distribution over tasks
Require: α, β: step size hyperparameters
randomly initialize θ
while not done **do**
  Sample batch of tasks $\mathcal{T}_i \sim p(\mathcal{T})$
  for all $\mathcal{T}_i$ **do**
    Evaluate $\nabla_\theta \mathcal{L}_{\mathcal{T}_i}(f_\theta)$ with respect to K examples
    Compute adapted parameters with gradient descent: $\theta_i' = \theta - \alpha \nabla_\theta \mathcal{L}_{\mathcal{T}_i}(f_\theta)$
  end for
  Update $\theta \leftarrow \theta - \beta \nabla_\theta \sum_{\mathcal{T}_i \sim p(\mathcal{T})} \mathcal{L}_{\mathcal{T}_i}(f_{\theta_i'})$
end while



(a)



(b)

Figure 3. (a) Model-Agnostic Meta-Learning (MAML) Algorithm, (b)Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) Algorithm

This algorithm integrates in FIg 3, the gradient-based update approach from MAML with evolutionary strategies from genetic algorithms. Through this combination, the model's initial parameters (meta-parameters) are refined using mutation, crossover, and natural selection mechanisms. Meanwhile, MAML's gradient updates speed up the search for optimal solutions within complex parameter spaces, making the algorithm more robust and better suited for nonlinear problems. EG-MAML Process Steps:

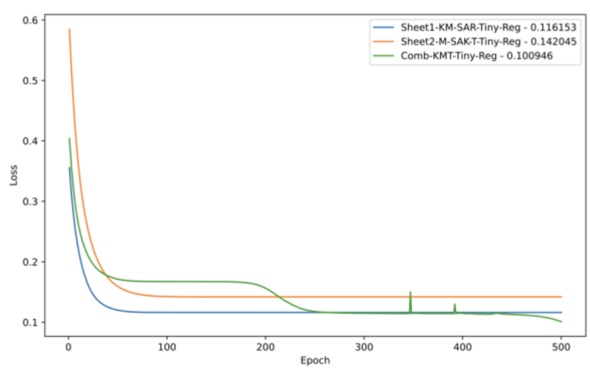
1. Population Initialization: Begin by generating a population of individuals, where each one represents a set of initial model parameters. This population is then evolved using genetic algorithm processes.
2. Selecting Meta-Learning Tasks: Choose several tasks from the available task distribution. These tasks are used to update model parameters during training.
3. Updating via MAML: Apply Model-Agnostic Meta-Learning (MAML) updates to improve each individual's parameters, enhancing the model's ability to tackle new tasks effectively.
4. Mutation and Crossover: After MAML updates, mutation and crossover are applied to adjust and combine individual parameters. Mutation alters a small subset of parameters, while crossover merges

parameters from two individuals to generate new offspring.

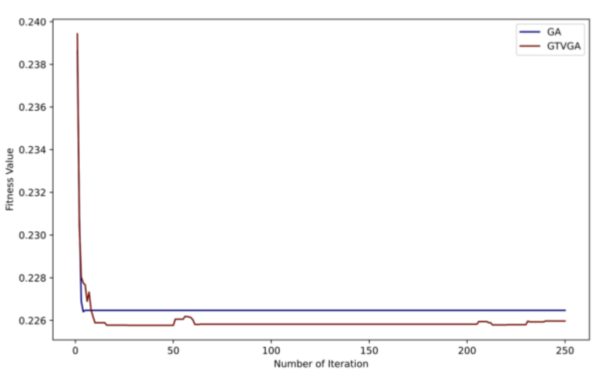
5. Evaluation and Elitism Selection: Each individual is assessed based on performance on the meta-learning tasks. The top-performing individuals are retained, while those with lower performance are modified or removed through natural selection.
6. Cycle Repetition: Repeat these steps until the model achieves optimal or near-optimal performance over multiple cycles.
7. Generalization and Prediction: After training, the model is tested on unseen tasks, aiming to allow rapid adaptation to new data and demonstrate strong generalization abilities.

III. RESULT AND DISCUSSION

During evaluation, the system uses the "Open Dataset Health" from hospital websites or other official sources. The results indicate that the GTVGA-based EG-MAML outperforms in terms of fitness values across all tested function scenarios. For instance, the search boundary format for the fitness function in the second scenario, fitness_ind_eg_maml_tp_2, is defined as: bounds_tp_2 = [(0, 8), # for seed; (0.001, 0.2), # for inner_step_size; (1, 14), # for inner_epochs; (0.001, 0.4), # for outer_stepsize_reptile; (0.0001, 0.1), # for outer_stepsize_maml; (1, 20), # for n_iterations; (0, 1) # for run type].



(a)



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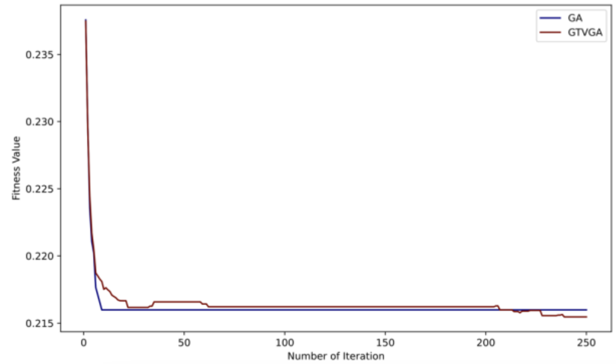

(c)

Figure 4. (a) Training Loss per Epoch for All Task, (b) Convergence of Mean Fitness Value for fitness_ind_eg_maml_tp_1, (c) Convergence of Mean Fitness Value for fitness_ind_eg_maml_tp_2

Based on Fig. 4, the GTV EG-MAML achieved a fitness score of 0.21484125, while the non-GTV version scored 0.21573043, showcasing the algorithm's effectiveness in handling health-related issues with enhanced precision. This algorithm's food recommendations offer users valuable guidance for maintaining health and preventing illness. The full code is accessible at https://github.com/imamcs19/Virtual-First-Aid-Box Prevent-n-Rescue-Body-Health-Using-Deep-Extreme-Genetic-MAML-Algorithm in the public repository.

IV. CONCLUSION

The Enhanced Virtual First Aid Box, created using the Deep Extreme Genetic Model-Agnostic Meta-Learning (EG-MAML) algorithm, has introduced notable advancements in identifying health conditions and delivering first aid support. The system processes each detection in approximately 1 to 3 seconds, achieving a strong fitness score of 0.21484125. Its ability to adapt to changing medical data makes the EG-MAML model a reliable solution for healthcare needs, enabling rapid responses in pre-emergency situations. While the system performs well, optimizing real-time monitoring with cloud-based medical sensors in hospitals could broaden its applicability across more health scenarios. Furthermore, working with larger datasets, set many optimizer method like Adam Annealling and many define model option (n_hidden_layers and custom activation) or others inside to MAML as additional chromosome gen in GTVGA would more enhance the system's metrics and reliability. The system could also be improved for greater flexibility by integrating a combination of multivariate treatment methods grounded in the green technology of Islamic Medicine, employing evolutionary strategies for contemporary practices that address both physical and non-physical aspects, such as engaging in acts of charity, reciting the Quran, performing prayers, salawat, and practicing dhikr and others.

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