IT4010 – Research Project - 2023

Topic Assessment Form

Project ID : TMP-2023-24-114

Important instructions to students:

1. **According to the comments given by the supervisor, make the necessary modifications and finally, get the approval from the Supervisor and the co-supervisor.**
2. **If the project topic is rejected, identify a new topic, and follow the process as before.**
3. **The approved form must be submitted to the folder (will be notified later) on or before 10th July 2023.**

(Students should ensure that they complete all sections ranging from 1 to 7. Then, download the form and email to your supervisor before 26th June 2023. Please note that the corresponding supervisor of the project is responsible for completing sections 8 to 10.)

1. Topic (12 words max)

Advancing Heat Resilience: Integrated Technologies for Targeted Interventions and Equitable Adaptation

2. Research area the project belongs to

Machine Learning and Soft Computing (MLSC)

3. Team member details

Student Name	Student ID	Specialization
Leader: T.D.Ranawaka	IT20142728	IT
Member 2: D.M.S.M Dissanayaka	IT20145552	IT
Member 3: T.M.S.B.Thelwadana	IT20645366	IT
Member 4: B.N.S.Gunadasa	IT20652500	IT

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

Heatwaves are increasing in frequency and intensity worldwide, posing significant risks to human health, infrastructure, and ecosystems. The impacts of heatwaves are not distributed equally, with vulnerable populations, such as the elderly, children, and economically disadvantaged communities, being disproportionately affected. Systemic inequalities further exacerbate the vulnerabilities of these groups, constraining their ability to adapt to heat stress and access protective measures. Addressing these challenges requires innovative approaches that combine advanced technologies, data analytics, and equitable policy frameworks.

The research problem revolves around enhancing heat resilience through the integration of automated vulnerability mapping, data-driven risk assessment, AI-powered early warning systems, and policy and governance frameworks. The aim is to develop targeted interventions that address the specific vulnerabilities of different communities while promoting equitable adaptation strategies. This research seeks to bridge the gap between identifying vulnerable groups and implementing inclusive strategies by leveraging cutting-edge technologies.

The research problem focuses on advancing heat resilience through the integration of automated vulnerability mapping, data-driven risk assessment, AI-powered early warning systems, and policy and governance frameworks. By leveraging these components, the research seeks to develop targeted interventions, enhance preparedness and response to heatwaves, and promote equitable adaptation strategies. Through innovative approaches and the application of advanced technologies, this research aims to address the complex challenges of heatwaves, vulnerability, and systemic inequalities, ultimately contributing to building more resilient and inclusive societies.

References:

Gillard, R., Gouldson, A., Paavola, J., Van Alst, D., & Westerhoff, L. (2018). Transformational responses to climate change: beyond a systems perspective of social change in mitigation and adaptation. WIREs Climate Change, 9(2), e510.

Smith, K., Woodward, A., Campbell-Lendrum, D., Chadee, D., Honda, Y., Liu, Q., ... & Sauerborn, R. (2020). Human health: impacts, adaptation, and co-benefits. In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Vargo, J., Pérez-García, J., Craig, R., Neeson, T., & Gray, S. (2019). Spatial modeling of heat vulnerability due to land cover and socioeconomic patterns in San Juan, Puerto Rico. Sustainability, 11(2), 531.

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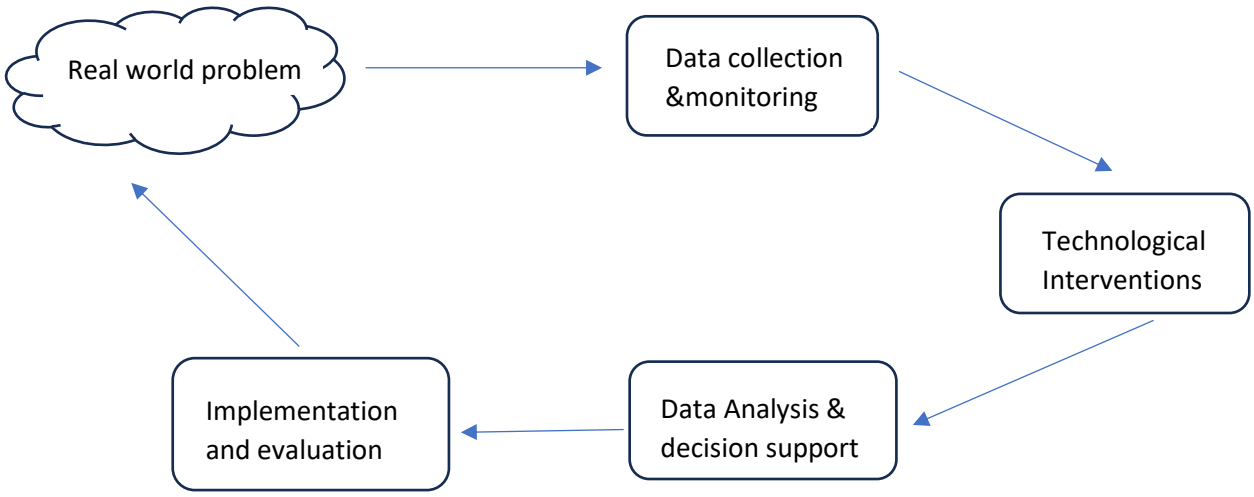
5.Brief description of the nature of the solution including a conceptual diagram (250 words max)



The Technological Solutions for Heatwave Adaptation component focuses on harnessing innovative technologies to address the challenges posed by heatwaves and enhance adaptive capacities. The nature of this solution lies in the application of advanced technological approaches to mitigate the impacts of heatwaves, promote resilience, and improve the well-being of communities.

The solution involves the integration of various technological interventions across different domains. These interventions include but are not limited to smart infrastructure and building design, urban heat island mitigation, personalized heat risk communication, and heatwave-resilient energy systems. By leveraging technologies such as sensors, data analytics, AI, and smart grids, these interventions aim to enhance heat resilience in multiple ways.

The solution emphasizes proactive measures such as real-time monitoring of weather conditions, enabling the implementation of adaptive strategies, and providing personalized guidance to individuals. It also highlights the importance of sustainable and energy-efficient approaches to reduce the strain on resources and minimize the environmental impact.

Through the application of these technological solutions, the research aims to mitigate heat-related risks, improve response capabilities, and empower individuals and communities to effectively adapt to heatwaves. The nature of the solution is dynamic, constantly evolving through data-driven insights, technological advancements, and community engagement, with the ultimate goal of building resilient and sustainable societies in the face of increasing heatwave occurrences.

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

Addressing the complex challenges of heatwaves, vulnerability, and systemic inequalities through technological solutions and adaptation strategies requires specialized domain expertise, knowledge, and access to diverse datasets. The research necessitates collaboration among multidisciplinary experts with expertise in the following areas:

1. Climate Science and Meteorology: Expertise in climate science and meteorology is essential for understanding the drivers of heatwaves, analyzing historical climate data, and projecting future climate scenarios. This knowledge is crucial for identifying trends, assessing heatwave risks, and developing accurate predictive models to support targeted interventions.

2. Data Analytics and Machine Learning: Proficiency in data analytics, machine learning, and AI algorithms is crucial for processing and analyzing large-scale datasets. This expertise enables researchers to identify patterns, correlations, and vulnerabilities associated with heatwaves, supporting evidence-based decision-making and the development of data-driven solutions.

3. Urban Planning and Architecture: Knowledge of urban planning and architecture is essential for designing heat-resilient infrastructure and urban environments. Experts

in this field can contribute to the development of strategies for mitigating urban heat island effects, optimizing shade provision, and promoting sustainable building design to enhance heat resilience.

4. Social Sciences and Equity Studies: Expertise in social sciences and equity studies is vital for understanding the social, cultural, and economic dimensions of vulnerability to heatwaves. This knowledge helps in identifying systemic inequalities, assessing community needs, and ensuring the integration of equity considerations in adaptation strategies.

Data requirements for this research include a range of datasets from various sources, including:

Meteorological data: Historical weather data, climate projections, and localized meteorological information are crucial for analyzing heatwave patterns, identifying hotspots, and understanding the climatic context of vulnerability.

Socioeconomic data: Demographic data, income levels, housing conditions, and other socioeconomic indicators provide insights into the social vulnerabilities and disparities that influence heatwave impacts on different population groups.

Health records: Health data, including heat-related illness and mortality statistics, help assess the health risks associated with heatwaves and inform targeted interventions for vulnerable populations.

Satellite imagery: High-resolution satellite imagery can be utilized to analyze land cover, urban heat island effects, and vegetation patterns, providing valuable information for urban planning and infrastructure design.

Community-based data: Engaging communities and collecting localized data through surveys, interviews, and participatory methods can provide context-specific insights into vulnerabilities, adaptation strategies, and community needs.

7. Objectives and Novelty

Main Objective

The main objective of this research is to advance heat resilience by integrating technological solutions, data-driven approaches, and inclusive strategies to mitigate the impacts of heatwaves and address systemic inequalities. The research aims to develop innovative interventions that enhance adaptive capacities, reduce vulnerabilities, and promote equitable adaptation strategies.

By leveraging advanced technologies such as machine learning, AI, and data analytics, the research seeks to achieve the following sub objectives.

Member Name	Sub Objective	Tasks	Novelty
T.D.Ranawaka	Soil Moisture detection and Forecasting	Long term impact on heatwaves on soil is a major issue cultivators face who are in affected areas. Measure the correct soil moisture will be critical for cultivating crops. Rather than using a traditional method to detect the condition of soil, using a data driven model will provide an accurate monitoring of soil moisture and prediction of a soil moisture requirements for their crops. The proposed system will estimate the surface soil moisture using data driven model by integrating optical thermal images from satellites using google earth engine.	

		Furthermore, we classify the heatwaves by the soil moisture levels and the temperature of the soil. These machine learning-driven solutions gives farmers and cultivators accurate forecasts and real-time monitoring of soil moisture conditions and offer adaptive techniques to detect negative effects of heatwaves on agricultural productivity.	
D.M.S.M Dissanayaka	Automated Vulnerability Mapping:	Develop automated methods using machine learning and AI algorithms to map vulnerability to heatwaves at various spatial scales. This component focuses on leveraging data from diverse sources, such as satellite imagery, demographic data, and climate datasets, to identify areas and populations most susceptible to heat-related risks. The aim is to provide policymakers and planners with accurate and timely information for targeted interventions.	

T.M.S.B.Thelwadana	Data-driven Risk Assessment:	Utilize advanced data analytics techniques to assess the risk and impact of heatwaves on different sectors, such as public health, infrastructure, and economy. By integrating historical and real-time data, including meteorological data, health records, and socioeconomic indicators, this component aims to provide evidence-based insights for developing proactive heat action plans and adaptive strategies	
B.N.S.Gunadasa	Policy and Governance Frameworks and Personalized Heat Risk Communication:	Investigate policy and governance frameworks that can address systemic inequalities and promote equitable adaptation to heatwaves. This component involves analyzing existing policies, regulations, and institutional arrangements to identify gaps and propose measures for integrating equity considerations into heat resilience strategies.	

8. Supervisor checklist (supervisors should fill sections from 8 to 10)

1. Is this research problem valid?

Yes		No	

2. Is the proposed research group, correct?

Yes		No	

3. Is the proposed research area, correct?

Yes		No	

4. Do the proposed sub-objectives match the students' specialization?

Yes		No	

5. Is the required domain expertise, knowledge, and the data available either through the supervisor or external supervisor?

Yes		No	

6. Is the scope of the solution practical?

Yes		No	

7. Do all sub-objectives have sufficient novelty?

Yes		No	

9. Your final decision:

Acceptable: Mark/Select as necessary

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

* Detailed comments given below

Comments

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor				
Co-Supervisor				
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				