



MANAGING SUB-SAHARA AFRICAN FOREST AND WILDLIFE RESERVED RESOURCES FOR CONTROLLING CLIMATE CHANGE WITH THE USE OF INFORMATION TECHNOLOGY BASED FOREST MONITORING ARTIFICIAL INTELLIGENCE (ITB/FMAI)

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ABSTRACT

Africa's forest and wildlife reserves are of great diversity, several of it surpassing that of many other places in the world. The variety of forest reserve and wildlife conservation and their unique habitats took the attention of tourists to the continent. Africa's forest reserve and wildlife conservation has been seen as a valuable asset to control climate change, and has been protected by different means. The value of forest and wildlife cut across climate change control, economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from wildlife tourism and the sale of wildlife products. The effect of human activities on African forest and wildlife growth and development calls for the training of the resources explorers most especially on the use of Information Technology based forest monitoring Artificial Intelligence for managing, protecting and preserving these resources. As a result of this, this, work focused on Managing Sub-Saharan African Forest Reserved Resources for Controlling Climate Change with the use of Information Technology Based Forest Monitoring Artificial Intelligence (FMAI). The paper also review related articles and come up with different monitoring strategies. In efforts to preserve the diversity of free-ranging forest and animals in Africa, various actors have suggested a various strategies for managing the resources.

Key words: Artificial Intelligence, Forest, Wildlife, ICT, Monitoring,, Managing, Climate Change

Introduction

Sub-Saharan African is blessed with forest and wildlife resources, managing and preserving these resources is the major challenge most especially during the COVIDS-19 global pandemic challenge. The use of Artificial Intelligence to manage and protect these resources during this global challenge is a welcome option. Artificial intelligence has been applied widely in our daily lives in a variety of ways and on various fields with lots of successful stories. AI equally contributes to dealing with the COVID-19 corona virus global pandemic disease which has been happening around the world (Simon, 2020). Forest and wildlife are essential part of resources that drive the world economy. This sector is affected on daily basis by human activities across the continent of Africa. Most especially during COVID 19 lock-down imposed to control the wild spread of the deadly disease. This is the reason why the ICT based monitoring Artificial

Intelligence for protecting and preserving these resources becomes highly imperative. The outbreak of COVID 19 global pandemic has profoundly changed the way we live our lives and carry out our day-to-day activities. The COVID-19 pandemic has dramatically accelerated the adoption of Artificial Intelligence (AI) in different fields. We have now witnessed the equivalent of some years of digital transformation compressed into just a few months. Monitoring different activities in African forest and wildlife during this period was very difficult. As a result of this challenge, the need for artificial Intelligence to enhance the monitoring of human activities on our forest reserve and wildlife conservation cannot be overemphasized.

African Forest and Wildlife Preservation

The sudden emerging of global COVID-19 pandemic crisis has changed all aspects of human life, including resources production together with the industries that the mining sector supplies. This has brought about a slowdown in the global economy as a result of efforts to control the spread of COVID-19 by imposing lock - down. However, the effect of the crisis on African forest and wildlife remains a subject of discussion. Most countries consider forest reserve and wildlife conservation as essential resources; the sector hit setback with diverse illegal human activities during the COVID-19 outbreaks. This challenge calls for the use of ICT based monitoring artificial intelligence to check mate future occurrence. The specific nature of forest and wildlife conservation that has direct impact on the global forest and wildlife sector may not be as significant as the impact on the economic value of this resources. The fact that forest reserve operations have remained closed during the COVID-19 crisis cannot be overemphasized. The economic effect of COVID-19 pandemic crisis may be sharp and deep but a return to economic normality may not be equally as rapid (Simon, 2020). Some governments allowed mining to continue during the COVID-19 pandemic with somewhat limited restrictions relating to COVID-19 mitigation (Table 1).

A complete shutdown occurred in some countries such as Mexico, where the mining industry was forced to cease operations on March 31, 2020, but was allowed to reopen on May 18, 2020. The South African government also initially approached their underground-dominated and often labor-intensive mining industry the same way, closing operations in March 2020 (Ramaphosa, 2020) but later changing this to only reduce mining capacity by 50%. it as well affected monitoring capacity of African forest and wildlife conservation. This challenging situation call for training of resources workers most especially on the use of ICT based monitoring Artificial Intelligence on managing, protecting and preserving Sub-Sahara African Forest reserve and Wildlife conservation during unfavourable situation.

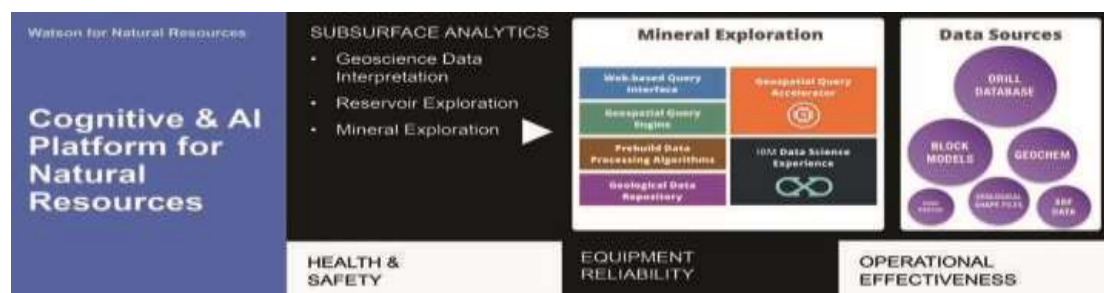


Fig. 1 Roundtable: How big data solutions of AI will lead to new mineral discoveries and Exploiration
 Source: Anthony (2021). Using Big Data and AI for Smarter Mineral Exploration 2020.

Artificial Intelligence and Mineral Resources Exploration, Protection and Preservation

The purpose of the round table is to leverage the potential of cloud computing, cognitive analytic and machine learning on mineral resources discovery, exploration and preservation. The objective is to make geologists more productive with the use of artificial intelligence which is a tool for them. We are not going to replace geologists ever but we can get them thinking more with the use of Technology, asking questions and getting quick answers. These are problems the round table discussion were trying to solve underground, with sparse information. It's not easy to achieve, so they are trying to use all of this technology with the support of and IBM's (International Business Machines) experience to build something new in mining industry to do this. From Figure 2 (Thanveer et al. 2022), If Artificial Intelligence could be used to monitor patient activities in the hospital it can as well be deployed to monitor illegal human activities in the forest reserve and wildlife conservation.

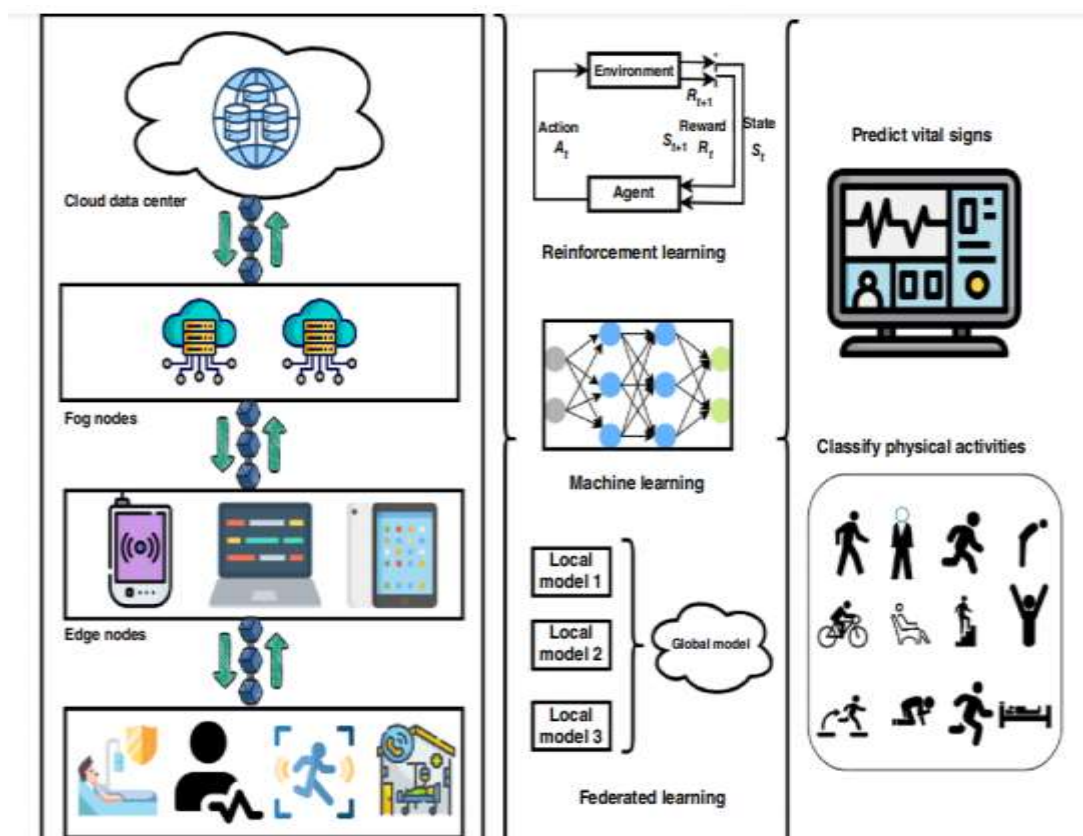


Figure 2, Artificial intelligence-enabled remote patient monitoring architectures, source: Thanveer et al. 2022.

Forest and wildlife monitoring architectures

The forest and wildlife guards monitored human activities in forest and wildlife conserved areas regularly and manually and maintained the records. Collecting wildlife activities are very vital in the forest reserve. The efficient of it depends on factors like personnel workload, staff working hours, wildlife activities, guard leadership, and national guidance (Smith et al., 2017) and was limited due to the lack of resources. The forest and wildlife monitoring was with invasive devices

requiring wildlives' skin contact to estimate their vital signs. Technological advancements in data transmission have disrupted the wildlife activities with non-invasive devices without touching wildlife's bodies and provided opportunities to monitor forest and wildlife continuously. The innovations will transform the traditional forest and wildlife monitoring and enabled monitor of forest and wildlife remotely in forest reserved wildlife conservation areas, this is where the use of forest monitoring Artificial Intelligence(FMAI) becomes necessary.

LITERATURE REVIEW

Olivier et al. (2020), worked on Edge Computing and Artificial Intelligence for Real-time Poultry Monitoring, International Workshop on Artificial Intelligence & Internet of Things (A2IoT). the work observed that smart poultry acquires data from aviaries with the use of sensor network at reduced intervals of time that generate millions of data. The combination of Internet of Things (IoT) and Artificial Intelligence open the field of the real-time monitoring of poultry and ,advance analytic and automation if data is from high quality. This work proposed a scalable monitoring of a poultry achieved with open hardware wireless sensors network and software.

Thanveer et al. (2022), worked on the Remote patient monitoring using artificial intelligence: Current state, applications, and challenges. The work explained that the adoption of artificial intelligence (AI) in healthcare is growing rapidly. Remote patient monitoring (RPM) is one of the common healthcare applications that assist doctors to monitor patients with chronic or acute illness at remote locations, elderly people in-home care, and even hospitalized patients. The reliability of manual patient monitoring systems depends on staff time management which is dependent on their workload. Conventional patient monitoring uses invasive approaches which needs skin contact to monitor health status. This work carried out a comprehensive review of RPM systems including adopted advanced technologies. The results of this reviewed work show that AI-enabled RPM architectures have transformed healthcare monitoring applications because of their ability to detect early deterioration in patients' health, personalize individual patient health parameter monitoring using federated learning, and learn human behavior patterns using techniques such as reinforcement learning.

Ruqiang et al. (2021), worked on AI-Enabled Monitoring, Diagnosis & Prognosis. The work stated that emerging and development of Artificial Intelligence (AI) particularly deep learning, has encouraged its application in various engineering domains. Monitoring, diagnosis and prognosis, as the key elements of intelligence maintenance of manufacturing systems in the era of Industry has also benefited from the advancement of AI technology. The main objective of this issue is to bring scholars to display their research findings in the fled of monitoring, diagnosis and prognosis driven by AI, and promote its application in intelligent maintenance of manufacturing system.

Adewumi et al. (2018), worked on the Issues, Challenges And Strategies Of Wildlife Conservation In Nigeria. This paper is a review of the state of nature conservation in Nigeria, and the measures put in place for the protection of the wildlife. The outstanding challenges which are bush burning of wildlife habitat, overgrazing of local animals, environment predation, over hunting, poaching and. lack of tourism. Efforts put in place to protect wildlife include declaration of priority sector at the national level for which funds should be earmarked, establishment of single agency to deal with all matters covered by the Convention. Certain species have been designated to be totally protected, and others may be hunted or captured only under special authorization, encouraging people to take up afforestation and conservation in new areas. It is advised that more national parks and conservation areas and existing ones should be protected, maintained and monitored.

Bridget (2018), worked on the Strategies for wildlife management in Africa. The work observed that Africa's wildlife is remarkable for its diversity, most of it surpassing that of many other places on earth. The variety of wildlife and their unique habitats took the attention of tourists and wildlife enthusiasts to the continent. Africa's wildlife has been seen as a valuable community asset, and has been protected by different means. The value of wildlife occurs for economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from wildlife tourism and the sale of wildlife products. In efforts to conserve the diversity of free-ranging animals, various actors have established a wide array of strategies for its management. Steve et al. (2016), worked on the Sustainable Management of Forests and Wildlife in Africa: Enhancing value, benefits and services. The work stated that sustainable forest management has been promoted as an important way to ensure the safety of the forests last from generation to generation. Increase in cropland and agriculture accounts for 60% of forest conversion in Africa, resulting in tremendous environmental footprint and disequilibrium. At the current rate, the future of human security in Africa —for basic food, fiber and shelter will be severely threatened by unsustainable practices. The work presents a win-win two-prong approach to achieving avoided deforestation through education on integrating tree cover in agricultural landscapes (Evergreen Agriculture).

Nina von and Halvard (2021); worked on the Security implications of climate change: A decade of scientific progress. The work observed that the security implications of climate change has developed rapidly from a nascent area of academic inquiry into an important and thriving research field that traverses epistemological and disciplinary boundaries. This work take stock of scientific progress by benchmarking the latest decade of empirical research against seven core research priorities collectively emphasized. It also discuss key contributions of this special issue and ind that the research community has made an excellent strides in specifying and evaluating plausible indirect causal pathways between climatic conditions and a wide set of conflict related outcomes and the scope conditions that shape this relationship.

Ajayi (2019), worked on Wildlife Conservation in Africa: A Scientific Approach. The work presents comprehensive management strategies for the consumptive and non-consumptive utilization of wildlife across Sub-Saharan Africa. It describes African economies that are currently affecting the high success of protecting, preserving and promoting wildlife.

METHODOLOGY

The methodology adopted in this work is to review related works on the use of ICT based monitoring Artificial Intelligence in protecting forest reserve and wildlife conservation in Sub-Saharan Africa. We analyse the difficulties faced by the forest and wildlife monitoring groups in securing African forest and wildlife against illegal human activities. The effectiveness of artificial intelligence as a monitoring device was observed. It was discovered that that Africa's forest and wildlife are spectacular for its diversity which surpassing that of many other places in other continents. Preserving these resources becomes imperative. The presence of forest reserve and wildlife conservation in Africa and their unique habitats invites the tourists and wildlife enthusiasts to the continent. Africa's wildlife has been seen as a valuable community asset, and has been protected by different means. The value of wildlife occurs for economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from wildlife tourism

and the sale of wildlife products. Monitoring this resources against illegal human activities with the use of ICT base monitoring Artificial Intelligence in this era of technology is the best idea.

Climate Change and the Challenges of Forest and Wildlife Conservation in Sub-Sahara Africa

Forest reserve is a key to controlling of climate change; climate change has brought about diverse natural happenings such as global warming and several other occurrences. Africa has forests and woodlands with wide varieties of wide life (Adewumi et al. 2018). The continent is home to biodiversity and vegetation in the region range from rainforest, savanna grasslands and desert. The wood lands and forests in Africa consist of wide species of plants, mammals, birds reptiles and aquatic animals. There are various species of plants, mammals, birds, reptiles and aquatic animals in Africa. Africa forest and wildlife is also famous in the Sub-Sahara Africa, Central Africa most especially the Congo Basin and South Africa. The forests in Africa are mostly tropical and savanna type. The forests are home to diverse mammals, reptiles, birds and aquatic animals. The forest and some species of animals are constantly endangered by illegal human activities. Government at different levels and various forest and wildlife agencies are making efforts to conserve and preserve them. In this era of technology the use of monitoring artificial intelligence would be of necessity. At the present time, forest reserves form a considerable part of Africa. Many of these forest reserves are too small to be of much importance for wildlife protection, but some of the larger forest reserves are the main refuges of many species of animals which are very rare or have been exterminated elsewhere. In the forest reserves, the exploitation of the trees are the main consideration, but the absence of hunting and illegal human activities had a beneficial effect on the forest and wildlife populations.

Strategies for Forest and Wildlife Preservation in Africa

Africa’s forest reserve and wildlife conservation is very spectacular for its abundance and diversity which surpassing that of many other places on earth. Preserving this valuable resources becomes highly imperative. Due to its value, it has been protected conventionally to check-mate illegal human activities. Despite this protection illegal human activities is still going unnoticed. The use of iCT base monitoring artificial intelligence can be of great advantage to put this illegal human activities on check. Forest reserve and wildlife provide employment and contributes to the national incomes of many countries through earnings from wildlife tourism and the sale of wildlife products (Bridget, 2018). It plays an essential role on the controlling of climate change, African savannas recreation and promoting diversification of ecosystems. Monitoring the African forest and wildlife resources with the use of (ICTb/AI) is highly needed. From table 1(Thanveer et al. 2022), if human activity could be monitored in the hospital with the use of human activity recognition with artificial intelligence it can also be used to monitor human activities in the forest.

Table1 Human activity recognition with artificial intelligence. source: Thanveer et al. 2022.

| Applications | Algorithm | Technology | References |
|--------------------------------|---|--|--|
| Physical Activities Monitoring | SVM, RF, KNN, naive Bayes, decision tree, adaptive boosting | Sensors, RFID Tags | Pan et al. (2020), Hsieh et al. (2021), Y. Wang and Zheng (2018), Zhu et al. (2017); Z. Wang et al. (2019) |
| | KNN, SVM, LSTM, CNN, HACNN | Wearable accelerometer, cloud, fog, edge | Salah et al. (2022), S. Yu et al. (2021) |

Forest and Wildlife Monitoring Architecture (F/WMA)

To effectively control climate change in Africa, remote forest and wildlife monitoring (RFWM) is a highly needed if African forest and wildlife conservation would be effective. The use of forest monitoring artificial intelligence in the forest and wildlife go a long way to assist the forest and wildlife monitoring teams. RFWM can be used to measure vital signs and activities in the forest or other physiological parameters such as motion recognition that can help to detect the intruders in the forest ant wildlife. Figure 3 shows Patient monitoring architecture. This architecture can also be designed to monitor the activities in the forest and wildlife. This will go a long way to protect and preserve the forest and wildlife conservation in Africa.

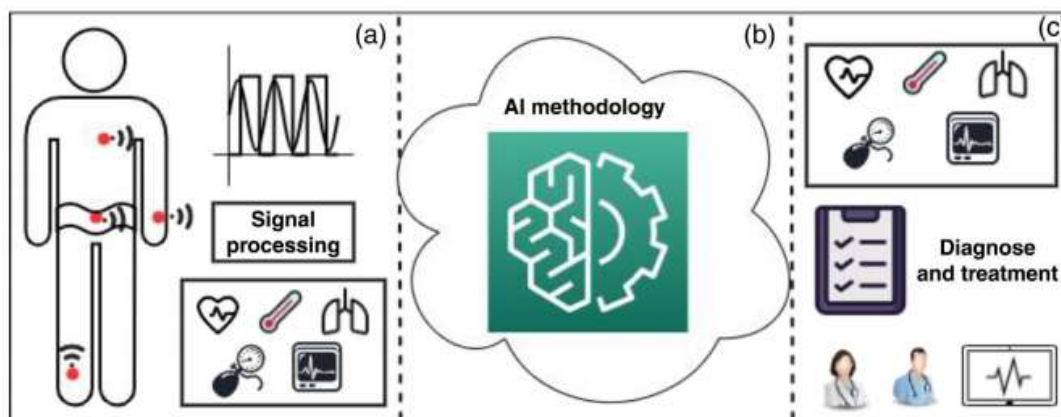


Figure 3 Patient monitoring architecture (inspired by Shao et al., 2020). source: Thanveer et al. 2022.

Discussions

Africa's forest reserve and wildlife conservation has been seen as a valuable asset to control climate change, and has been protected by different means. The value of forest and wildlife cut across climate change control, economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from wildlife tourism and the sale of wildlife products. The effect of human activities on African forest and wildlife growth and development calls for the training of the resources explorers most especially on the use of Information Technology based forest monitoring Artificial Intelligence for managing, protecting and preserving these resources which among other things will help to control climate change.

Summary

This research work has established the necessity of using forest monitoring artificial intelligence to preserve, protect and promote African forest reserve and wildlife conservation respectively. The reviewed works showed that the technology approaches to wildlife conservation that have been described will achieved a great successes to promote climate change control. And the use of forest monitoring artificial intelligence will play an important role in Africa forest and wildlife biodiversity conservation strategies. Forest and wildlife managements all over Africa

who also believe in the protection of forest and wildlife and animal rights advocates should take the use of forest monitoring artificial intelligence seriously.

Conclusion

Africa is blessed with a very rich and unique array of ecosystems and great variety of forest and wildlife, but the conservation of these resources remains topic of discussion (Adewumi et al. 2018). These challenges cut across bush burning, overgrazing, inconsistency of policies guiding forest reserve and wildlife conservation, lack of funds to promote forest reserve and wildlife conservation from the government at all levels, Lack of experienced and trained forest and wildlife personnel; hunting of game resources, illegal procurement of protected wildlife such as fish, game and logging activities, lumbering and other illegal human activities across African forest. These challenges facing the sustainability of forest reserve and wildlife conservation and management in Africa could be get rid of with the use of ICT based forest monitoring artificial intelligence could be introduced.

Recommendations

To encourage the protection, preservation and promotion of forest and wildlife in Africa the following recommendation should be considered:

- a. Workshop / seminar should be designed on the use of forest based artificial intelligence to monitor the illegal human activities in the forest.
- b. Government at all level should establish a policy that will support the The use of use of forest based artificial intelligence to monitor the illegal human activities in the forest.
- c. Well trained personnel should be employed to monitor the activities being carried out in the forest.
- d. More forest reserve and wildlife conservation should be established and the existing ones should be maintained.

References

- Adewumi, A.A, Idowu, E.O and Oyeniran, B.H (2018): Issues, Challenges And Strategies Of Wildlife Conservation In Nigeria, International Journal of Life Sciences Research, 6(2): (37-44).
- Agboola, O. and Emmanuel, M, (2016): Awareness of Climate Change and Sustainable Development among Undergraduates from two Selected Universities in Oyo State, Nigeria, World Journal of Education, 6(3): 70-81.
- Ajayi, S.S. (2019): Wildlife Conservation in Africa A Scientific Approach.pp. ISBN: 978-0-12-16962-9, DOI <https://doi.org/10.1016/C2018-0-01944-1> pp. 251-261
- Anthony, V. (2021): Using Big Data and AI for Smarter Mineral Exploration, is based on the exploration round table: How big data can lead to big new discoveries which took place at the Progressive Mine Forum in Toronto, Canada. The one-day mining and exploration innovation event was organized by The Northern Miner, with the support of IBM and other sponsors.
- Bridget, B.U. (2018): Strategies for wildlife management in Africa: Actors, successes and failures, pp. 382-408.
- Davenport, T.; Kalakota, R. (2019): The potential for artificial intelligence in healthcare. Future Healthc. (6): 94-98.
- Nina von, U. and Halvard B. (2021): Security implications of climate change: A decade of scientific progress, Journal of Peace Research, 58(1): 3-17.
- Olivier, D., Said, M., Sidi, A. M., Pierre, M., Jerome, B. and Frederic. (2020): Edge Computing and ArtificialIntelligence for Real-time Poultry Monitoring, International Workshop on Artificial Intelligence & Internet of Things (A2IoT) August 9-12, 2020, Leuven, Belgium, Procedia Computer Science 175 (2020): pp. 534-541.
- Ruqiang, Y., Xuefeng, C., Weihua, L. and Robert, X. G. (2021):AI-Enabled Monitoring, Diagnosis & Prognosis, Chinese Journal of Mechanical Engineering, Springer Open Journal, (2021): 34:68
- Steve, M., Michae,l N., Jolien, S. and Evan, B., (2016): Sustainable Management of Forests and wildlife in Africa: Enhancing value, benefits and services, Food and Agriculture Organization of the United Nations, 30(2): 1-117.
- Thanveer, S., Xiaohui, T., Niall, H., Lin, L., Raj, G., Xujuan, Z. and U. R. A. (2022): Remote patient monitoring using artificial intelligence: Current state, applications, and challenges, Wiley Online Library, DOI: 10.1002/widm.1485. pp. 1-11.