Innovative methods for identifying invasive species: AI, IoT, Drones, biotechnology and robotics

Timur Gadzhievich Aygumov[1,*], *Movsar Musaevich* Matygov[2], and Ruzana Aslanovna *Shomakhova*[3]

[1]Dagestan State Technical University, Makhachkala, Russia
[2]Kadyrov Chechen State University, Grozny, Russia
[3]Kabardino-Balkarian State University, Nalchik, Russia

Abstract. New technologies and their use for different area allows humans to achieve tasks in more advantageous ways. New technologies combined with other technologies are drastically changing the world we live in. Every day, the capabilities of some technologies are increasing exponentially and thus opening doors for new applications. One of the areas that uses these new technologies is unconventional. Understanding the behavior of alien or invasive species can have beneficial impact on different ecosystems. Uncontrolled spread of these species can put ecosystems in danger. Therefore, the identification and control of these species is a must. There are different ways of reaching the necessary solution, but this work will try to outline the new technologies used to identify and control these species. The following technologies will be covered: Artificial intelligence, Internet of Things, drones, and robotics.

1 Introduction

It is hard to digest the fact that some species of plants that can survive harsh environment and bloom amidst other species can have a dangerous impact on the ecosystem and to the environment. The latest observations show that the planet is suffering in some of its parts, due to the absence of enough green, and therefore the local environment is in danger of collapsing. The absence of plants and other form of livings can put the system to death and prevent it from further improvement. However, there is a solution, that is most of the time suitable, which is the introduction of alien species to the environment that has lack of its own greenery. Alien species or invasive species can benefit is some areas and similarly can put the whole system to degradation.

Alien or invasive species can be described as species that are introduced to the ecosystem intentionally or unintentionally. In simple terms, these species are not belonging to the system they are spreading. There are different paths that can lead to the introduction of these species to a new ecosystem. The first one is intentional introduction to supplement the lack of some greenery and accelerate the generation of ecosystem trough alien species. The other

*Corresponding author: 915533@mail.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

way of introduction of these species is the unintentional one, in which the seeds or shoots accidentally enter the ecosystem. Due to globalization, the occurrence of these seeds and shoots have become more frequent in the areas they should not be. Hence, the appropriate monitoring and control must be accomplished.

They are called invasive not because they can invade a new territory and coexist with the ecosystem by complementing the empty chains, but because they invade and diminish all other form by progressing in the dominance of the system. This could lead to irreversible changes. As we all know, every species plays a significant role in the system. Even collapse of one species could start a chain of collapse of others. Therefore, new technologies must be used to monitor and control these species in a new ecosystem. The work will try to outline the use of new technology in the identification and further analysis of alien species [1, 2, 3].

Fig. 1. Generated image of invasive species through Pixlr

2 Alien species and the new technology

The following paragraph will look into the use of new technology in identifying alien species among other species in different scenarios. As it was mentioned earlier, it is essential to track the spread of alien species in the areas that they do not belong. Alien species plays a major role in some ecosystems, which can have a positive and negative influence. Therefore, new technologies such as artificial intelligence, drones, internet of things and robotics will be covered in this work.

2.1 Artificial intelligence

This technology combined with others allows the possibility to identify any species in their habitant. The latest improvement of artificial intelligence opened doors to many possibilities. Its application can be found in almost any industry. Even our day-to-day task involves using this technology. Sometimes the technology's present is obvious and sometimes not. By itself, the technology is just complex algorithms that try to mimic human brains capabilities. However, combined with other technology, its potential increases exponentially each year. The application of technology is diverse. It can be found most of the time in entertainment industry. Imagery videos, music, and text are greatly influenced by this technology. Medicine, law, agriculture and many more are applying artificial intelligence to elevate their capability to the next level. One can see it range of application and can conclude its massive impact on humans. Artificial intelligence can be used with other technology to identify alien species for further instruction [4].

This technology can be used to recognize the imaginary of different species, including alien species. Machine learning can be used to construct the chain of algorithms, where fed data of alien species in different scenarios can be analyzed for its future identification. There are many tools (software and apps) in the market that allows the user to take or download a picture (video) and hence to identify any species that it is capable of identifying. These tools are used by the industries and common man for identification. There are also a lot of algorithms in the market that can be modified for the narrowed purpose [5].

Another application of artificial intelligence in alien species can be data analysis. This technology is used to analyze large datasets of environmental variables, species distributions, and ecological interactions to identify patterns associated with invasive species. By identifying the pattern, it can suggest the areas of risk and the action that can be taken to solve the occurred issues. The tool can be used for prediction. By providing data, the technology is capable of modelling the spread of invasive species. This helps researchers to understand the nature of invasive species and how they interact and sometimes conquer the ecosystem. The tool also can be worked on identifying other parameters. For instance, how weather, vegetation, and land properties can influence the alien species [6, 7].

2.2 Internet of Things

The previous technology can be used only on visual appearance. However, there is technology that can expand the capabilities further. This technology is called Internet of things. Combined with other technology, Internet of things can analysis in depth. With the use of sensors, Internet of things is capable of measuring different parameters such as temperature, humidity, light and so on. Internet of Things is a technology that allows different devices, apparatus, home appliances and other similar things to communicate with each other via interned or any other way of connection. Artificial intelligence is well utilized in this technology. Massive data from all connected objects needs to be analyzed for appropriate results. Therefore, artificial intelligence is applied for data analysis. In the area of alien species, this technology can be used to measure parameters influencing alien species. For example, how moisture is the land, the value of different elements in the area where they spread, the available light, human and animal interaction with the species. These and other parameters can be measured with the utilization of Internet of Things with built-in artificial intelligence [8, 9].

2.3 Drones and robotics

This technology also has a great influence on identifying the spread of alien species. Drones are used for different task related with alien species. In general, they are well embedded in different industries and forum their niche. They are greatly applicable in different areas and finding new application each coming years. With the occurrence of lighter materials and new generation of engine drones transformed many industries drastically. Similar to other technology, drones need different technologies to reach to its maximum capabilities. Drones greatly use artificial intelligence and Internet of Things and various technologies. With the build in sensors and artificial intelligence they can in real time identify different objects including alien species. Internet of Things allows it to communicate with the station, where all decisions are made. Drones can easily identify the spread of invasive species from a distance and mark on the map. This gives ability for different type of actions. One of the actions is to send different drone with the tool that can stop the spread of alien species. It is obvious that various drones built for different scenarios and use. Hence, combined with other technologies, drones can perform different action to alien species [10, 11].

Different type of robots can be used to identify and control alien species. Where drone analyses and act from above robots are working on ground. They can perform different tasks depending on the structure and the aim. Robots can identify alien species from the ground and act accordingly. Or use the data from the drones or sensor and then travel to the species and perform prebuild functions. The other way is when they are controlled by the operators in the focused region. There are many different technologies used for identification of alien species and for their control. These technologies can be a group of technologies connected in way for achieving maximum capabilities or stand-alone technology that can perform a point task [12, 13].

3 Conclusion

To conclude, the work was done to outline the technologies for identifying and controlling the alien species. Alien or invasive species needs to be controlled if they occur in the areas that are less secure to defend itself. Spread of such species can put the whole system in danger of changing or completely disappearing. They are not always bad for the ecosystem, but the control must be implemented through the use of different tools. Therefore, the work tried to illustrate that there are different new technologies that can be used for identification and monitoring alien species and the spread. This work also explained the need for the use of these technologies. It is obvious that in the nearest future we will know how to use these alien species for the benefit of ecosystem. Until then, the use of these technologies will help to prevent further loss of diverse systems.

References

1. A. Ricciardi, Invasive Species. Ecological Systems (2013)
2. S.N. Cherny, R.F. Gibadullin, International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), Sochi, Russian (2022)
3. M.A.K. Khalil, M.J. Shearer, C.L. Butenhoff, Z.Q. Xiong, R.A. Rasmussen, L. Xu, X. Guangxi, Emissions of Greenhouse Gases from Rice Agriculture (2019)
4. I. Magomedov, M.S-U Khaliev, L.V. Ibragimova, The need for introducing new technology in agriculture to ensure a sustainable future. OP Conf. Ser.: Earth Environ. Sci., **548**, 032026 (2020)

5. Union of Concerned Scientists, The science of invasive species, The Science of InvasiveSpecies (2001)
6. I. Magomedov, M.S-U. Khaliev, A. Bagov, Agriculture and its contribution to global warming, IOP Conf. Ser.: Earth Environ. Sci., **548**, 032029 (2020)
7. I. Magomedov, K.V. Mashukov, G.I. Gaptullazyanova, Precise farming through end-to-end technologies. E3S Web of Conferences, **451(24)**, 03008 (2023)
8. S. Neethirajan, Artificial Intelligence & Sensor Innovations— Enhancing LivestockWelfare with a Human-Centric Approach. Preprints, 2023090214 (2023)
9. I.A. Magomedov, M.S.-U. Khaliev, L.V. Ibragimova, the need for introducing new technologyin agriculture to ensure a sustainable future IOP Conference Series: Earth and Environmental Science, 548 (2020)
10. V.A. Gerasimov, M.G. Nuriev, D.A. Gashigullin, 2022 International Russian Automation Conference (RusAutoCon), 75-79 (2022)
11. O.A. Fernandez, J.L. Ordóñez-Ávila, I.A. Magomedov, Evaluation of parameters in aneural network for detection of red ring pest in oil palm. AIP Conference Proceedings, **2442(1)**, 030015 (2021)
12. B. Meskhi, Neural networks as a promising direction in the agricultural industry. E3S Web of Conferences, **460(154)** (2023)
13. S. Grabowska, S. Saniuk, B. Gajdzik, Industry 5.0: Improving humanization and sustainability of Industry 4.0., Scientometrics, **127**, 3117-3144 (2022)