

UDC 65.011.54:63

## DESIGN OF AN AUTOMATED AGRICULTURAL ROBOT AND ITS PRIME ISSUES

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Article info

Received  
29.02.2020

Accepted  
24.03.2020

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*Mohapatra, B. N., Mohapatra, R. K. (2020). Design of an automated agricultural robot and its prime issues. Scientific Horizons, 03 (88), 19–25. doi: 10.33249/2663-2144-2020-88-3-19-25.*

*In order to understand how to improve the agriculture based production and how to increase crop performance in the right way and to understand the importance of automatization we should require the mechanism and control application. The work with this agricultural environment is very hard because of the weather like rainy season, winter and summer. The development of robot can perform different tasks and easily operate by the operator. It can perform the task like fertilizer or water sprinkler or drilling and seeding seeds. Mainly the agricultural robot has its design and construction. Different controlled law performs different kinematic tasks and should test the working model. The demand and shortage of labour forces particularly in agricultural field based on the automatization of industry for demanding of such agricultural robot or farming robot to perform smart farming.*

*Increasing of global population is creating demand for more amounts of food, as well as agricultural work is also highly dependent on manpower and labour. This paper finds several latest achievements from robots in terms of automatization in farming sector. As majority Indian's depends on agriculture, so it is very important to design some advanced robots and require reducing of different issues. The researcher has tried to develop the economy of the country through smart farming robots. As it is known, automatisations increases making higher profit, so problems and issues associated with agricultural robot can be overcome with implementation of new mechanism, advanced algorithm and with modern technology in future. With the help of workshop and based on this new robot engine, this robot industry can take this agricultural industry as an ocean in some ways.*

**Key words:** agriculture, drilling, seeding, sprinkler, proteus, automatization.

### Introduction

Increasing of global population is creating demand for more amounts of food, as well as agricultural work is also highly dependent on manpower and labour. Rising population boosts have huge demand for wheat and rice (Trestle & Seeley, 2013). Rapid deterioration of working people for farming sector forces different researchers to put some important intelligence factors which can be implemented through robot automatisations technology (Tartar, 2018; Vaccines *et al.*, (2019). Nowadays weeding robot was designed (Chen *et al.*, 2018). It was also making replacement of hard

weeding. More than 40 percentages of the people choose primary occupation in agriculture. The work of farmers recently has decreasing due to time consuming and less awareness about automatisations and advance technology. So, the conceptual approach should carry the agricultural process (Knickel *et al.*, 2009).

Actually there should be more and more robots. So that it can hold all kind of mechanical tools for handling the harvesting part of soil. Basically robot can be used as moving vehicle where one can use as conventional ways to spray. Normally someone should think about exact planning before it will be on the working field. So that robot can easily decide

where the plants are and where the robot is allowed to move. So good planning is important. More modern equipment is invented which can help the massive spray in a larger field. Sprinkler can be used normally in gardens (Tangtisanon, 2019). Modular robot as well as small cheap robot can work 24×7 (Pecka & Osadcuks, 2018). Robot is an electro mechanic system where software programming takes place and can make complicated tasks easily. Applying agriculture with automatisisation will helped farmers to save time and money (Marinouidi *et al.*, 2019).

### Ease of use in agriculture

Ploughing is the important process because it is the process of preparing the land for seed sowing. Depending on the types of seeds, logic is applied to the controller so that robot will get the exact instruction for the performance. For seeds there will

be seed chambers and leveller is also fitted close to the seeds of the soil. Spray of water can be possible through water pump sprayer. The basic elementary factor as planting, grafting, weeding, harvesting is made by the robot easily.

Now research also proceeds on image processing and special purpose web so that photo can be captured and robot will be ready to cut the unwanted grass in the crop field. Using sensors like moisture, temperature, humidity, one should get the proper information about how to do it and find the decision and can make better recommendation to the controller through logic implementation. One will perform because robot can work nonstop but humans need rest after some period of time. Less human power is required. Also human cannot perform to complete the work under hazardous environment (fig. 1).

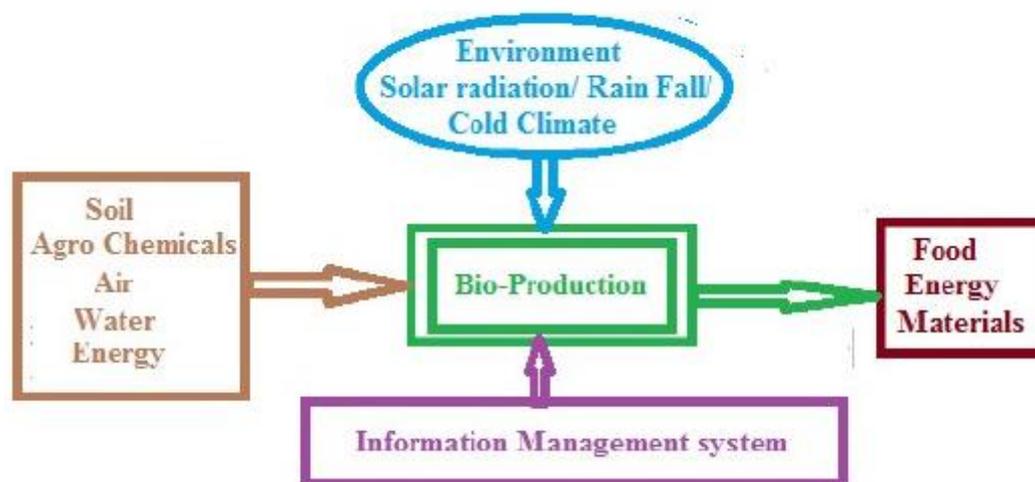


Fig. 1. Agricultural production systems

Through automatisisation ploughing, seeding, fertilizing, weeding, harvesting and spraying are made easily. To reduce the manpower by utilizing robot does the task easily with saving time. Modern agriculture and farms operations will work on sophisticated technology such as smart sensors, smart robots with additions artificial intelligence and big data analysis. All these advanced technologies are safer, efficient and more profitable and environmentally friendly. Figure 1 shows the overall agricultural production system (Friedrich *et al.*, 2017).

Figure 3 shows that man can utilize the innovative ideas either in terms of IOT, bluetooth, android based, raspberry or voice based control to the agricultural robot for performing well in farming industry. Solar power irrigation system is also helpful

for the agricultural system (Jadhav *et al.*, 2016; Mohapatra *et al.*, 2018; Mohapatra *et al.*, 2019).

### Prototype model of agricultural robot

Robot usually has parts like sensors, drive or actuator, controller and end effectors. Normally sensors send the information to the controller and controller, which is brain of the robot, will give right instruction to the robot. Actuator normally produces motion and for this someone can use any kind of motors like pneumatic, stepper, DC or servo motor as the required application. Simple robot can follow the steps shown in figure 2 for basic work in agriculture. Figure 4 and figure 5 have a sharp rod position at the back side of the robot of prototype and solid work model has figure 6 and 7. It has the ability to fissure in the ground due to the controller instructions. Seeds

can be planted as it comes from the funnel. A water tank is connected with tubes and motor pumps for sprinkling. Here we are using DC motor and the operation of robot as a prototype model which is shown in the figure 6 as well as in figure 7.

Metallic piece can be used for fertilizer by giving the exact command to the controller then it will act due to the field size and its direction.

### Simulation result

Here we are implemented a simple coding for PIC18f4550 and run the robot. For that purpose we need L293D motor driver circuit. PIC18f4550 can be used as model design and implementation (Buji et al., 2019).

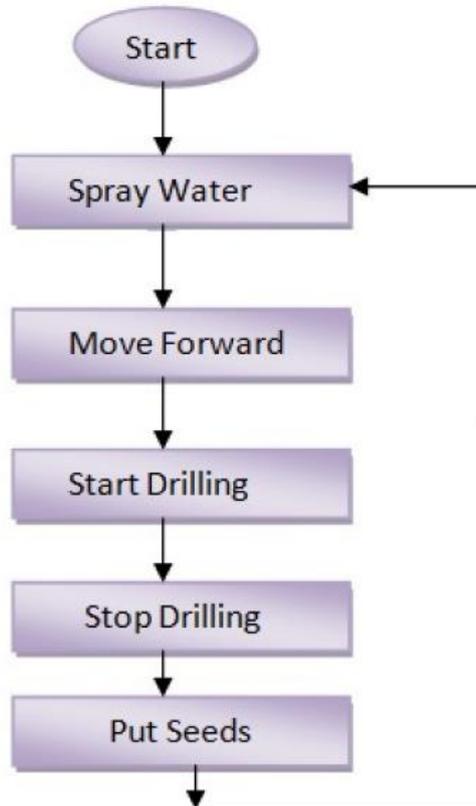


Fig. 2. Basic design flow of a robot in farming

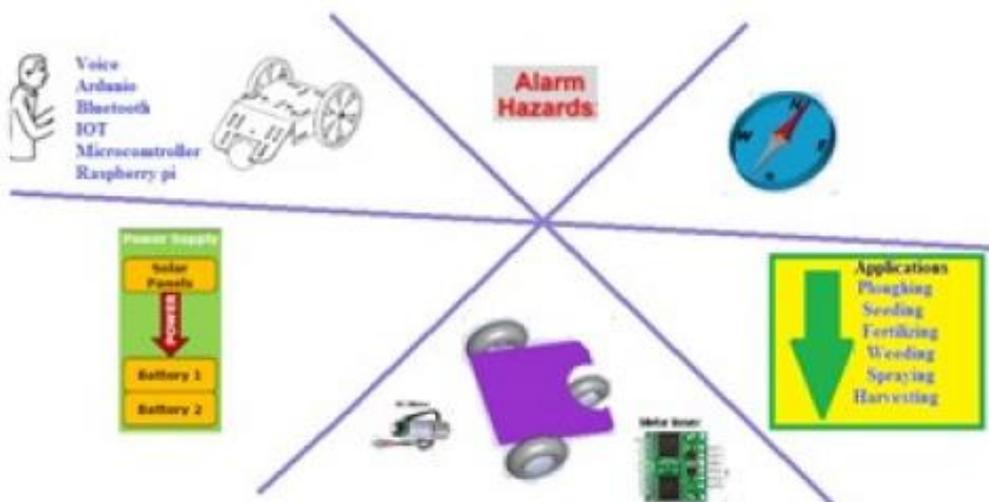
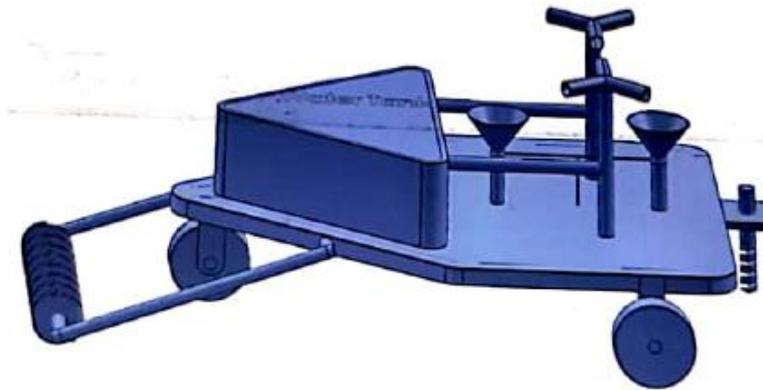
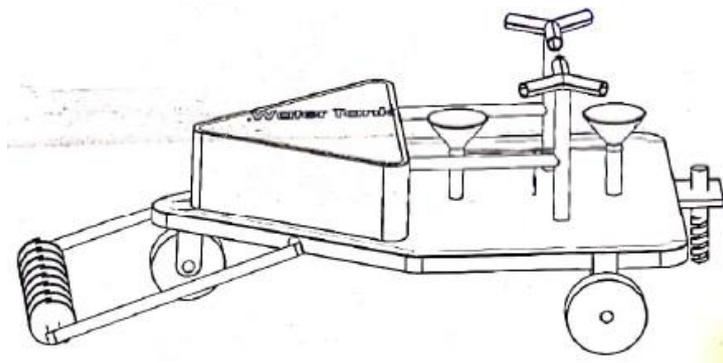


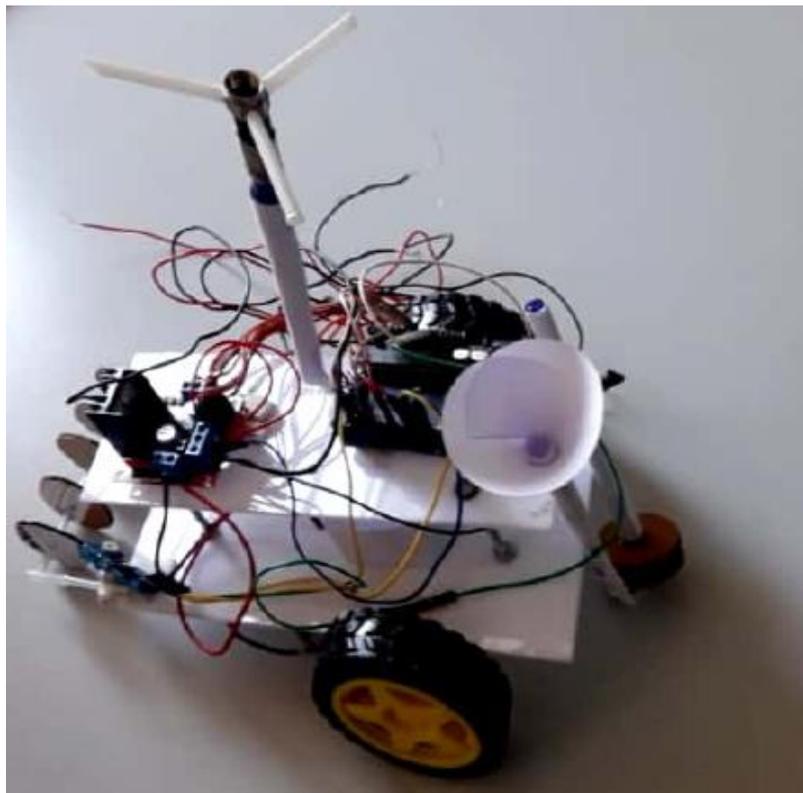
Fig. 3. Basic design flow of a robot in farming



**Fig. 4. Robot has tools like sprinkler, drilling, fertilizer**



**Fig. 5. Solid work design for robot structural view**



**Fig. 7. Side view of prototype model**

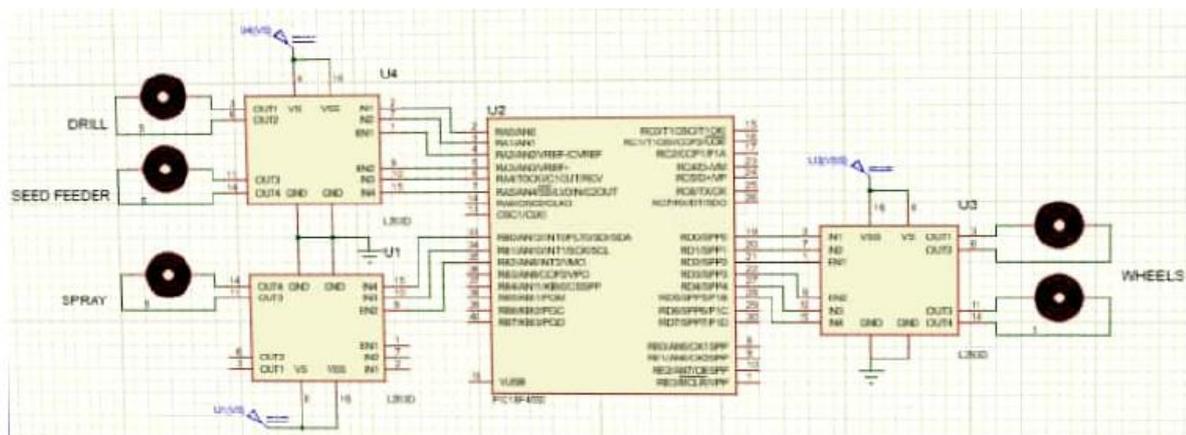


Fig. 8. Proteus schematic capture

Microcontroller is an inexpensive, easy handling, low cost and low power consumption. Also it is more flexible. It has 40 pin counts and its operating voltage is 2 to 5.5 volt (Nor Ayuni Abdu Maid, 2013). Weed detection also can be possible by agricultural robot (Bhong et al., 2020). Microcontroller also plays a

vital role either in terms of position or in terms of tracking. Table I shows that robot farming system has a lot of advantages in comparison of traditional methods. Based on tracing method one can easily implemented the line follower while seeding in agriculture (Mohapatra et al., 2019).

Table 1. Basic comparisons on methods used in farming

Main parameters	Traditional vs tractor vs robot		
	traditional	tractor	robot
Man power	more	moderate	less
Speed	slow	high	very high
Time require	more	less	less
Energy require	high	very high	less

Robot technology has really helped to improve productivity of food production. Also there are certain challenges and issues (Berducat, 2018; Velontrasina et al., 2019). There are even some special type of security issues in IOT based system (Nayak et al., 2020). The main factor in India is expensive (Bangar et al., 2019). There are some issues for this utomatisation like handling the product output as fruits as its shape varies from time to time. If there will be some unstructured environment or an object may require changing the instructions then user must know how to solve that situation. Even if the robot machine size will be very large then the ground pressure goes up but the plants do not need the ground pressure. Due to the ground pressure, it is not suitable for plants growing. So, the size and the weight should be minimum. Sometimes GPS based controlled machines crushed farm land and makes it more tightly. While the robot is working, if there will be rain then there will be chance to stop the process. So the system of controlling transport used in the robot

needs safety prevention. Sometimes the prise can also effect to the poor farmer, as either they have to purchase or they could take the rent of the equipment. In some cases the farmer may ask the instructor if the situation is unusual. For specific purpose special tools or modules can be utilized in farming industry. But someone should know everything about the sensor placement, battery placement or the oil requirement. Sometimes knowledge of these advanced robot technology may not help operators or users. Normally agricultural or farming robot needs repetitive decisions for emergency work as it is only sensed by the sensors and controller gives all instructions to the robots. No doubt that multi imaging system, high resolution cameras, GPS monitoring system are not unique set of challenges but designer should focus on several factors. The robot should be operated in different environmental condition with special issues on obstacle avoidance and path planning, again weed crop classifications, fruit quality estimation, compactness of the soil.

## Discussion

Normally small farmers get adopt this new robot technology in the agricultural industry. It should be of great interest when farmer will be free from driving tractors. The farmers cannot work for a long time. This kind of robot can help them in production of crops. Also small number of people is interested in farming work. To income a good amount of money farmers usually leave the farms and go into the cities. The advanced version of robot technology can assist the farms by simple learning of mechanism of driving the tractor without driving. Specifically the advancements of artificial intelligence, Internet and smart robots can have the capabilities to have enough evolutions in agriculture. The research may help to find what kind of nutrient will be require to the soil for better crop production as well as robot can detect and regulate the accurate quantities.

## Conclusion

As for the different field layouts and looking at the different environment, the robot should be configurable (its size and shape). Also it should be based on crop variety, maturity and its size. It must ensure that will move in a safe motion and it must be protect from the environment. As environment changes a lot so we have came up with satellite map to the robot system for its running. By utilizing some new methods someone can do this. The 3D structure, perspective view and stereo vision can make more novelty to the robot system. As advancement of technology the robot may have the abilities to fit in terms of size, softness, colour of the product.

The systematic approach for the overall process which includes determination of the intensive level applied. This specific design is required for agricultural robot for performing by looking for process with keeping eyes on prise benefit analysis. As the future prospect, further implement can make all farming mechanism incorporate with automatic operation with keeping as low cost as a crucial factor so that excellent mass production could reduce its cost with some extent. As it is known, automatisisation increases making higher profit, so problems and issues associated with agricultural robot can be overcome with implementation of new mechanism, advanced algorithm and with modern technology in future. With the help of workshop and based on this new robot engine, this robot industry can take this agricultural industry as an ocean in some ways.

## References

- Bangar, S., Shelar, P., Alhat, P. & Budgugar, R. (2019). Multipurpose Agricultural Robot. *International journal of innovative research in technology*, 6 (7), 105–108.
- Berducat, M. (2018). Some challenges to address in order to target the second generation of agricultural robots. *MCG 2018 6th International Conference on machine Control and Guidance* (pp. 5–11). Berlin.
- Bhong, V. S., Waghmare, D. L., Jadhav, A. A., Bahadure, N. B., Bhaladar, H. K. & Vibhute, A. S. (2020). Design farming robot for weed detection and herbicides applications using image processing. In *Techno-societal 2018*, Proceedings of the 2nd International Conference on Advanced Technologies for Societal Applications (pp. 413–422). Springer.
- Buji, A. B., Mshelia, Y. P., Ibrahim, A. G. & Sarki M. A. (2019). Model design, simulation and control of a robot arm using a microcontroller. Retrieved from [https://www.academia.edu/39355397/MODEL\\_DESIGN\\_SIMULATION\\_AND\\_CONTROL\\_OF\\_A\\_ROBOTIC\\_ARM\\_USING\\_PIC\\_16F877A\\_MICROCONTROLLER](https://www.academia.edu/39355397/MODEL_DESIGN_SIMULATION_AND_CONTROL_OF_A_ROBOTIC_ARM_USING_PIC_16F877A_MICROCONTROLLER).
- Chen, L., Karee, M., He, L., Wei, Yu. & Zhang Q. (2018). Evaluation of a levelling system for a weeding robot under field condition. *IFAC-Papers Online*, 51 (17), 368–373.
- Friedrich, T., Drench, R. & Assam, A. (2017). Overview of the global spread of conservation agriculture. In Etingoff, B. (Ed.). *Sustainable development of organic agriculture* (pp. 75–90). Palm Bay, Florida : Apple academic press. doi: <https://doi.org/10.1201/9781315365800>.
- Jadhav, S. & Hambarde, S. (2016). Android based automated irrigation system using raspberry. *International journal of science and research*, 5 (6), 2345–2351. doi: <http://dx.doi.org/10.21275/v5i6.NOV164836>.
- Knickel, K., Brunori, G., Rand, S. & Proost, J. (2009). Towards a better conceptual framework for innovation processes in agriculture and rural development: from linear models to systemic approaches. *Journal of Agricultural Education and Extension*, 15 (2), 131–146. doi: <https://doi.org/10.1080/13892240902909064>.
- Marinoudi, V., Sorensen, C. G., Pearson, S. & Bochtis, D. (2019). Robots and labour in agriculture. A context consideration. *Bio systems engineering*, 184, 111–121. doi: <https://doi.org/10.1016/j.biosystemseng.2019.06.013>.

- Mohapatra, B. N., Husain, K. U. J. & Mohapatra, R. K. (2019). Implementation of a line follower robot using microcontroller. *International journal of innovative technology and exploring engineering*, 9 (2), 2155–2158.
- Mohapatra, B. N., Mohapatra, R. K. & Panda, P. (2019). Path guidance system for blind people. *International journal of open information technologies*, 7 (5).
- Mohapatra, R. K., Mohapatra, B. N., Nandwana, A., Singh, N., Mishra, A. & Yadav S. (2018). Solar power based irrigation system. *International journal of technology*, 8 (1), 16–22.
- Nayak, P., Kavitha, K. & Rao, C. M. (2020). It enabled agricultural system applications, challenges and security issues. *Analytics for agriculture*. 139–163. Springer.
- Nor Ayuni Abdu Maid (2013). Autonomous fire protection robot with notification. (PhD thesis). University Tun Hussein Onn Malaysia.
- Pecka, A. & Osadcuks. V. (2018). Conceptual design of modular multi functional agricultural mobile robot. *Research for rural development*, 1, 202–206. doi: 10.22616/rrd.24.2018.031
- Tangtisanon, P. (2019). Small gardening robot with decision-making watering system. *Sensors and Materials*, 31 (6), 1905–1916. doi: <https://doi.org/10.18494/SAM.2019.2176>.
- Tartar, A. (2018). Farming for freedom: the shackled Palestinian agricultural sector. In Zurayk, R., Woertz, E. & Bahn, R. (Eds.). *Crisis and conflict in agriculture* (pp. 144–156). Beirut : American University of Beirut.
- Trestle, R. & Seeley, R. (2013). Developing countries dominate world demand for agricultural products. Retrieved from <https://www.ers.usda.gov/amber-waves/2013/august/developing-countries-dominate-world-demand-for-agricultural-products/>.
- Vaccines, J. P., Kantor, G. A. & Aunt Cheein, F. A. (2019). Human-robot interaction in agriculture: A survey and current challenges. *Bio systems engineering*, 179, 35–48. doi: <https://doi.org/10.1016/j.biosystemseng.2018.12.005>.
- Velontrasina, I., Payet, D. & Courdier, R. (2019). Regulation function for agent adaptation issues in ambient environment. In *Proceedings of the 11th international conference on computer modelling and simulation* (pp. 246–249). New York : Association for Computing Machinery. doi: <https://doi.org/10.1145/3307363.3307376>.