e-ISSN: 2614-8404
p-ISSN : 2776-3234

Optimization of Extreme Programming Methods in Plastics Waste Management Company Websites

Linda Perdana Wanti [1*)], Oman Somantri[2], Annisa Romadloni[3], Eka Tripustikasari[4]
[1,2,3]Department of Informatics, Politeknik Negeri Cilacap
[4]Department of Informatics, Universitas Amikom Purwokerto
Email: [1]lindaperdana16@gmail.com, [2]oman.mantri@yahoo.com, [3]annisaromadloni@pnc.ac.id, [4]ekatripustikasari@amikompurwokerto.ac.id

Abstract – Plastic waste needs to be handled properly according to its type to reduce its negative impact on the earth, such as the issue of global warming which is still being widely discussed among the public. Good and correct plastic waste management has a significant long-term impact on the issue of global warming. Using the optimization of the extreme programming (XP) method to develop a plastic waste management system. With the system development method used, namely extreme programming, this system helps the community to be aware of waste and manage waste as well and wisely as possible. Extreme programming flexibility supports all changes that occur during the process of building this plastic waste management system. The output produced in the construction of this system is the management and sale of plastic waste that can be recycled according to its type. With usability testing that has been carried out, this system has been evaluated and shows a result of 88.07%, this value means that the plastic waste management system is well accepted to be used in plastic waste management.

Keywords – Extreme Programming, Information System, Optimization, Plastics Waste, Usability.

I. INTRODUCTION

The increasing plastic consumption must be wisely and inevitably balanced with its management [1]. Movements to prevent global warming are still often campaigned on social media and others to raise awareness of the importance of correct waste management hence not to add to the burden of the earth [2], [3]. Waste management system is built to identify, separate and manage plastic waste according to type [4], [5]. Good waste management starts from the smallest unit, which is house hold. The waste is collected based on its type, which is recyclable and unrecyclable waste [6], [7]. There will be a further process for recyclable waste, whereas the unrecyclable ones are collected and sorted to its type [8]. Some studies can be used as reference for plastic waste management to reduce the impact of pollution caused by it including [9], which is about recycling plastic waste due to the increasing use of plastic. The use of *Triboelectrostatic* technology by utilizing different surface properties of materials is for these materials to be distinguished in electric charge, deflected in an electric field and collected in separate places. In conclusion, this research recycles plastic therefore it can be reused with *Triboelectrostatic* technology. Other studies by [10] are the utilization of plastic waste with catalytic pyrolysis techniques. The catalytic pyrolysis process itself is a thermochemical decomposition process of organic matter through the process of heating, either using little oxygen or not using oxygen or other chemicals at all. The point is that plastic waste is processed through the pyrolysis process to get new materials that can be utilized. The material can be oil or something else. However some other research examples use plastic waste, namely [11], [12], [13] and [14].

The process of developing a plastic waste management information system use extreme programming method. Optimization of extreme programming methods is to accommodate all changes from the identification and planning process, the system design process, the process of implementing the design into the system, including coding, the system testing process using the testing method and implementing the system to the user [15]. Extreme programming approach is widely used because this method is able to anticipate some problems for example when the system is too fast in making changes, whereas the needs are not clearly defined [16]. The use of extreme programming methods in several studies that have been carried out include [17] implements the XP method in web applications for job training participant selection. The XP method is used to anticipate web development which consists of a small team. Furthermore, in [18], the XP method is used in making customer service complaints applications with university as the research objects. The XP method is able to accommodate all the needs and application development processes relatively quickly with minimal team members. Research by [19], applied the XP method to an online sales system where the system was built with a relatively fast deadline [20]. The impact of using XP method approach to the system which is being built is that the customer does not take a long time during online reservation [21]. However some other research examples use plastic waste, namely [22],

The difference between this research and previous research is that this research optimizes the extreme programming method approach in the construction of a plastic waste management system is used so that the system can be utilized well, considering the system was built with a small team and underwent several considerable changes in a fast time during the building process [23]. Some of the advantages of the XP method are the most optimized and effective, according to the state of the plastic waste management system [24]. With this system, the company is helped because it can maximize what the company has to be optimized and from a social point of view it helps reduce environmental impacts due to waste that is not managed properly [10]. The company gets two profits, namely profits from sales and waste management as well as

e-ISSN: 2614-8404
p-ISSN : 2776-3234

participating in maintaining the balance of the earth from wastes that take a long time to process until the waste can be reused.

II. RESEARCH METHODOLOGY

The system development method used for managing plastic waste is by optimizing the extreme programming method. The XP method approach in this case creates a plastic waste management system by minimizing the iteration that will later be carried out. Optimization in terms of iteration in the system development process by making the system from scratch has been endeavored to meet all user needs. A small or minimal developer teams is not a significant obstacle because the team's performance is maximized according to their respective parts. Figure 1 explains the detailed process of the extreme programming method.

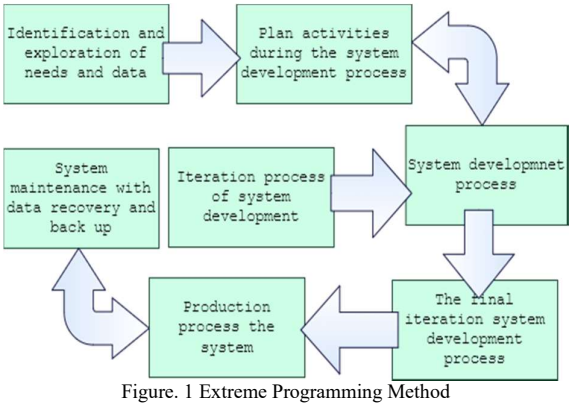

Figure. 1 Extreme Programming Method

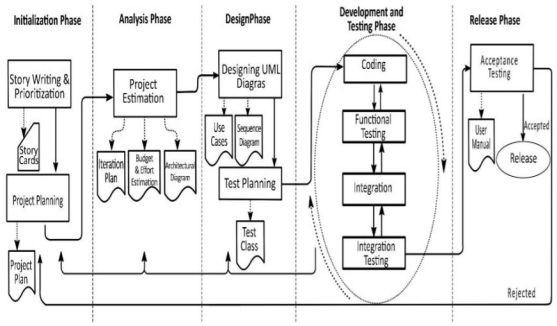

Figure. 2 XP Research Framework

Figure 2 describes the working steps of the extreme programming method which consists of 5 stages/phases. The first step is to initiate end-user needs which are translated and documented into story cards and project planning regarding the activities carried out in the next stages [25]. The second step is the analysis phase. After the system and user requirements are initiated, the results will be analyzed according to the estimated target system development required. The third stage is the design phase, where this phase translates the results of the system requirements analysis into designs such as UML designs, namely class diagrams, activity diagrams, sequence diagrams, use case diagrams and many others [26]. The next stage is to develop the system that was developed and test it with end-users to find out things that are still not in accordance with the needs of end-users and improve them according to feedback and end-users. At this stage, it is necessary to know that it is possible to return to the previous stage in accordance with the direction of improvement from the user. Can goes back to the initiation stage or to the analysis stage or to the design stage. For some projects that have been developed, this iteration usually goes back to the design stage. End users will provide a lot of input and system developers must improve in the system design section. At this stage usability testing is also carried out on the developed system. Usability testing itself is carried out to find out how easy it is for users to use the developed system so that system developers know the end users' difficulties in using the system and find out the shortcomings of the developed system [27]. To determine user satisfaction with the developed system, the measurement uses the following equation:

$$S(\%) = \frac{\sum_{i-1}^{n} X_i}{5*n} * 100\% \quad (1)$$

Description:
S : Satisfaction
X : Respondent success score
n : Number of respondents

In addition to end-user satisfaction, the level of effectiveness and efficiency of the developed system also needs to be measured to determine the success rate of the system using the user's success rate, which is the percentage of tasks completed correctly by the end-user [28]. To measure the level of system effectiveness and system efficiency using the following equation:

$$Ef\&Es(\%) = \frac{\sum_{i-1}^{n} X_i}{n} * 100\% \quad (2)$$

Description:
Ef & Es : Efficiency & Effectiveness
X : Respondent success score
n : Number of respondents

Meanwhile, to measure the usability of the system to determine the average of the effectiveness, efficiency and satisfaction of end-users using the equation below [29] :

$$U(\%) = U\ (\%) = \frac{Ef+Es+S}{3} * 100\% \quad (3)$$

Description:
U : Usability
Ef : Efficiency
Es : Effectiveness
S : Satisfaction

The last stage is the release phase, where at this stage, the system has reached the stage of being reproduced and ready to be implemented in many places according to the initial plan [30]. The system has reached the final stage and there is no further improvement from the end-user.

III. RESULTS AND DISCUSSION

It starts with defining and exploring all processes and needs as well as the data that will be used in system development [31]. The second stage is planning the activities which are carried out and the data that has been collected. They are then defined and grouped according to their needs. Next is the system development process with a minimum iteration process which is conditioned and planned at the beginning of the system development

e-ISSN: 2614-8404
p-ISSN : 2776-3234

process which is suited in accordance with user requirements. After the iteration process is carried out and finished, it is followed by the production stage of the plastic waste management system by defining all the designs and coding stages until the system is successfully built and tested by the user. The final step in optimizing the extreme programming method is the process of maintaining the system by both performing system recovery and backing up the system periodically.

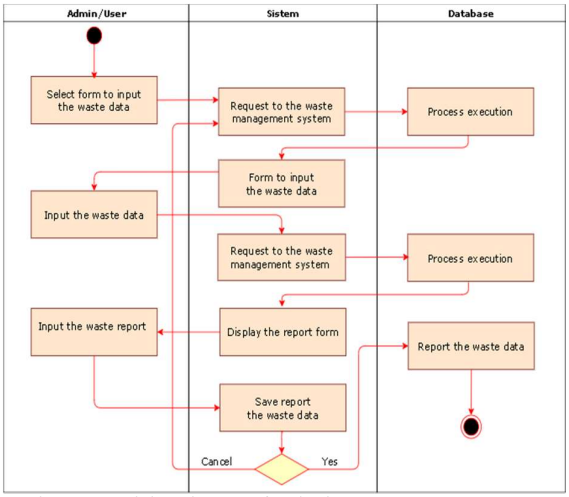

Figure. 3 Activity Diagram of a Plastic Waste Management System

Figure 3 explains the activity diagram of a plastic waste management system. Activity diagram starts from the request form or module user request to the system, where the user requests a form to enter the data of incoming or outgoing waste. The request is responded by the system and the incoming / outgoing waste form is prepared by the database to be transferred to the system and displayed to the user. The user fills in the incoming / outgoing waste form and saves it into the database, and then the request for storing the incoming / outgoing waste form is responded by the system [32]. The system proceeds to the database to execute the stored process for the incoming / outgoing waste form that has been filled. Then the user request to the system to fill in the incoming / outgoing waste report form. The response is responded by the system and forwarded to the database. The database prepares the report form for incoming / outgoing waste, and after the form is filled in by the user, the user saves the form to the database. The storage request is forwarded to the system with the response of the incoming / outgoing waste form has been stored in the system database.

Figure. 4 Main page of the Plastic Waste Management System

Figure 4 displays the main page of the plastic waste management system. There are 4 modules, namely a master for managing data from incoming and outgoing waste, a transaction module for the process of selling and supplying plastic waste and a report module for displaying reports from data input and transaction processes that have been running. Finally, there is exit menu to exit the application.

Usability testing was carried out on the plastic waste management website at PT. HR involved 27 respondents. The respondents consisted of directors, admins and employees of PT. HR, in addition to partners from PT. HR is also a respondent. Usability testing is used to measure respondents' satisfaction with the developed system, namely a plastic waste management website, the effectiveness and efficiency of a website-based system for plastic waste management [33]. For the measurement of self-satisfaction using equation (1) [34]. While the measurement of the level of effectiveness and efficiency of the system uses equation (2) [27]. Previously, the questionnaires distributed to 27 respondents were analyzed, as shown in the following table:

Table 1. Evaluation Elements for the Level of Satisfaction, Effectiveness and Efficiency

Satisfaction Evaluation Element	Effectiveness and efficiency Evaluation Elements
This app is interesting	Scenario to unlock system
This app is easy to use	Scenario for website menu functions
You will suggest friends use this app	Scenario for button function on each form
Reading the text on the screen is very easy	Scenario for master menu
The color composition corresponds to	scenario for partner data input
The image displayed is attractive	scenario for plastic waste data input
The buttons are easy to understand	Scenario for partner transaction menu function
The buttons are easy to use	Scenario for the plastic waste transaction menu function
Website materials are easy to understand	Scenario for report menu function
The language used is easy to understand	Scenario to exit the system

The results of measuring the level of satisfaction, the level of effectiveness and efficiency of the plastic waste management website at PT. HR is done twice. First, before there is input from the end-user, second after the system is repaired on the basis of user feedback for 3 iterations. The first iteration focuses on system design, the second iteration improves the function of the buttons on the menu on the website, and the third iteration improves the system login function. The graph of the results of usability testing is shown in Figure 5 below:

e-ISSN: 2614-8404
p-ISSN : 2776-3234

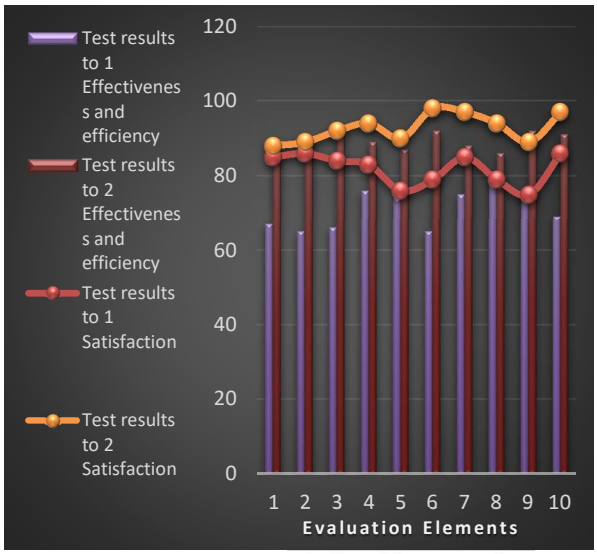

Figure. 5 Main page of the Plastic Waste Management System

The results of the usability of the website-based plastic waste management system based on the average satisfaction level of the 1st and 2nd tests as well as testing the 1st and 2nd level of effectiveness and efficiency of the system using equation (3) are as follows:

$$U\ (\%) = \frac{89.2+86.7+88.3}{3} * 100\% = 88.07\%$$

IV. CONCLUSION

From the research that has been done, the output produced is a plastic waste management website. Utilization of this website is also used to minimize the impact of plastic waste which is increasingly uncontrollable. A plastic waste management website was built and developed by implementing and optimizing the extreme programming method that is easily adapted for the construction of a system with a relatively short time and significant changes [10]. Iterations were carried out during the construction of the plastic waste management website 3 times by accommodating all feedback from end-users to improve the plastic waste management website according to end-user needs. Usability testing is 88.07%, this shows that the website-based plastic waste management system can be accepted by users to be used and can be used by companies to manage incoming and outgoing plastic waste.

REFERENCES

[1] Zhang, H., Pap, S., Taggart, M. A., Boyd, K. G., James, N. A., & Gibb, S. W. (2019). A review of the potential utilisation of plastic waste as adsorbent for removal of hazardous priority contaminants from aqueous environments. *Environmental Pollution*, *xxxx*, 113698. https://doi.org/10.1016/j.envpol.2019.113698

[2] Li, X., Ling, T. C., & Hung Mo, K. (2020). Functions and impacts of plastic/rubber wastes as eco-friendly aggregate in concrete – A review. *Construction and Building Materials*, *240*, 117869. https://doi.org/10.1016/j.conbuildmat.2019.117869

[3] Anuar Sharuddin, S. D., Abnisa, F., Wan Daud, W. M. A., & Aroua, M. K. (2016). A review on pyrolysis of plastic wastes. *Energy Conversion and Management*, *115*, 308–326. https://doi.org/10.1016/j.enconman.2016.02.037

[4] Kaliyavaradhan, S. K., Ling, T. C., Guo, M. Z., & Mo, K. H. (2019). Waste resources recycling in controlled low-strength material (CLSM): A critical review on plastic properties. *Journal of Environmental Management*, *241*(December 2018), 383–396. https://doi.org/10.1016/j.jenvman.2019.03.017

[5] Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Science of the Total Environment*, *566–567*, 333–349. https://doi.org/10.1016/j.scitotenv.2016.05.084

[6] Mwanza, B. G., & Mbohwa, C. (2017). Drivers to Sustainable Plastic Solid Waste Recycling: A Review. *Procedia Manufacturing*, *8*(October 2016), 649–656. https://doi.org/10.1016/j.promfg.2017.02.083

[7] Wedayani, N. M. (2018). Studi Pengelolaan Sampah Plastik Di Pantai Kuta Sebagai Bahan Bakar Minyak. *Jurnal Presipitasi : Media Komunikasi Dan Pengembangan Teknik Lingkungan*, *15*(2), 122. https://doi.org/10.14710/presipitasi.v15i2.122-126

[8] Moharir, R. V., & Kumar, S. (2019). Challenges associated with plastic waste disposal and allied microbial routes for its effective degradation: A comprehensive review. *Journal of Cleaner Production*, *208*, 65–76. https://doi.org/10.1016/j.jclepro.2018.10.059

[9] Wu, G., Li, J., & Xu, Z. (2013). Triboelectrostatic separation for granular plastic waste recycling: A review. *Waste Management*, *33*(3), 585–597. https://doi.org/10.1016/j.wasman.2012.10.014

[10] Miandad, R., Barakat, M. A., Aburiazaiza, A. S., Rehan, M., & Nizami, A. S. (2016). Catalytic pyrolysis of plastic waste: A review. *Process Safety and Environmental Protection*, *102*, 822–838. https://doi.org/10.1016/j.psep.2016.06.022

[11] Al-Harahsheh, M., Al-Nu'Airat, J., Al-Otoom, A., Al-Hammouri, I., Al-Jabali, H., Al-Zoubi, M., & Abu Al'Asal, S. (2019). Treatments of electric arc furnace dust and halogenated plastic wastes: A review. *Journal of Environmental Chemical Engineering*, *7*(1), 102856. https://doi.org/10.1016/j.jece.2018.102856

[12] A., G. K., K., A., M., H., K., S., & G., D. (2019). Review on plastic wastes in marine environment – Biodegradation and biotechnological solutions. *Marine Pollution Bulletin*, *May*, 110733. https://doi.org/10.1016/J.MARPOLBUL.2019.110733

[13] Saleem, J., Adil Riaz, M., & Gordon, M. (2018). Oil sorbents from plastic wastes and polymers: A review. *Journal of Hazardous Materials*, *341*, 424–437. https://doi.org/10.1016/j.jhazmat.2017.07.072

[14] Horodytska, O., Valdés, F. J., & Fullana, A. (2018). Plastic flexible films waste management – A state of art review. *Waste Management*, *77*, 413–425. https://doi.org/10.1016/j.wasman.2018.04.023

e-ISSN: 2614-8404
p-ISSN : 2776-3234

[15] Tolfo, C., & Wazlawick, R. S. (2008). The influence of organizational culture on the adoption of extreme programming. *Journal of Systems and Software*, *81*(11), 1955–1967. https://doi.org/10.1016/j.jss.2008.01.014

[16] Schneider, J. G., & Johnston, L. (2005). eXtreme Programming - Helpful or harmful in educating undergraduates? *Journal of Systems and Software*, *74*(2 SPEC. ISS.), 121–132. https://doi.org/10.1016/j.jss.2003.09.025

[17] Supriyatna, A. (2018). Metode Extreme Programming Pada Pembangunan Web Aplikasi Seleksi Peserta Pelatihan Kerja. *Jurnal Teknik Informatika*, *11*(1), 1–18. https://doi.org/10.15408/jti.v11i1.6628

[18] Azdy, R. A., & Rini, A. (2018). Penerapan Extreme Programming dalam Membangun Aplikasi Pengaduan Layanan Pelanggan (PaLaPa) pada Perguruan Tinggi. *Jurnal Teknologi Informasi Dan Ilmu Komputer*, *5*(2), 197. https://doi.org/10.25126/jtiik.201852658

[19] Gumelar, T., Astuti, R., & Sunarni, A. T. (2017). Sistem Penjualan Online Dengan Metode Extreme Programming. *Jurnal Telematika*, *9*(2), 87–90.

[20] Anwer, F., & Aftab, S. (2017). SXP: Simplified Extreme Programing Process Model. *International Journal of Modern Education and Computer Science*, *9*(6), 25–31. https://doi.org/10.5815/ijmecs.2017.06.04

[21] Wanti, L. P., Ikhtiagung, G. N., & Pangestu, I. A. (2021). *Implementasi Extreme programming Pada Website Marketplace Lapak Petani Online*. *12*(01), 50–58. https://doi.org/10.35970/infotekmesin.v12i1.427

[22] Fojtik, R. (2011). Extreme programming in development of specific software. *Procedia Computer Science*, *3*, 1464–1468. https://doi.org/10.1016/j.procs.2011.01.032

[23] Rahmi, R., Sari, R., & Suhatman, R. (2016). Pendekatan Metodologi Extreme Programming pada Aplikasi E-Commerce (Studi Kasus Sistem Informasi Penjualan Alat-alat Telekomunikasi). *Jurnal Komputer Terapan*, *2*(2), 83–92.

[24] Roky, H., & Meriouh, Y. Al. (2015). Evaluation by Users of an Industrial Information System (XPPS) Based on the DeLone and McLean Model for IS Success. *Procedia Economics and Finance*, *26*(0), 903–913. https://doi.org/10.1016/s2212-5671(15)00903-x

[25] Tabassum, A., Manzoor, I., Shahid, D., Rida, A., & Imtiaz, D. (2017). Optimized Quality Model for Agile Development: Extreme Programming (XP) as a Case Scenario. *International Journal of Advanced Computer Science and Applications*, *8*(4), 392–400. https://doi.org/10.14569/ijacsa.2017.080453

[26] Anwer, F., Aftab, S., Shah, S., & Waheed, U. (2017). Comparative analysis of two popular agile process models: extreme programming and scrum. *International Journal of Computer Science and Telecommunications*, *8*(2), 1–7.

[27] Doerfler, R. M., Diamantidis, C. J., Wagner, L. A., Scism, B. M., Vaughn-Cooke, M., Fink, W. J., Blakeman, T., & Fink, J. C. (2019). Usability testing of a sick-day protocol in CKD. *Clinical Journal of the American Society of Nephrology*, *14*(4), 583–585. https://doi.org/10.2215/CJN.13221118

[28] Holmes, S., Moorhead, A., Bond, R., Zheng, H., Coates, V., & McTear, M. (2019). Usability testing of a healthcare chatbot: Can we use conventional methods to assess conversational user interfaces? *ECCE 2019 - Proceedings of the 31st European Conference on Cognitive Ergonomics: "'Design for Cognition,'"* 207–214. https://doi.org/10.1145/3335082.3335094

[29] Korableva, O., Durand, T., Kalimullina, O., & Stepanova, I. (2019). Usability testing of MOOC: Identifying user interface problems. *ICEIS 2019 - Proceedings of the 21st International Conference on Enterprise Information Systems*, *2*(Iceis), 468–475. https://doi.org/10.5220/0007800004680475

[30] Aldave, A., Vara, J. M., Granada, D., & Marcos, E. (2019). Leveraging creativity in requirements elicitation within agile software development: A systematic literature review. *Journal of Systems and Software*, *157*. https://doi.org/10.1016/j.jss.2019.110396

[31] Wanti, L. P., & Romadhon, S. (2020). Implementasi Forward Chaining Method Pada Sistem Pakar Untuk Deteksi Dini Penyakit Ikan. *Infotekmesin*. https://doi.org/10.35970/infotekmesin.v11i2.248

[32] Suryanto, T. (2018). Penerapan E-Marketplace pada Distro Silver Squad. *Konferensi Nasional Sistem Informasi (KNSI) 2018*, *0*(0), 8–9.

[33] Liu, Y. C., Chen, C. H., Lee, C. W., Lin, Y. S., Chen, H. Y., Yeh, J. Y., & Chiu, S. Y. H. (2016). Design and usability evaluation of user-centered and visual-based aids for dietary food measurement on mobile devices in a randomized controlled trial. *Journal of Biomedical Informatics*, *64*, 122–130. https://doi.org/10.1016/j.jbi.2016.10.001

[34] Russ, A. L., Jahn, M. A., Patel, H., Porter, B. W., Nguyen, K. A., Zillich, A. J., Linsky, A., & Simon, S. R. (2018). Usability evaluation of a medication reconciliation tool: Embedding safety probes to assess users' detection of medication discrepancies. *Journal of Biomedical Informatics*, *82*, 178–186. https://doi.org/10.1016/j.jbi.2018.05.002