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Automatic Alkaloid Removal System

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Abstract: This alkaloid automated removal machine was developed at Instrumentation Laboratory, Universiti Sultan Zainal Abidin Malaysia that purposely for removing the alkaloid toxicity from *Dioscorea hispida* (DH) tuber. It is a poisonous plant where scientific study has shown that its tubers contain toxic alkaloid constituents, dioscorine. The tubers can only be consumed after it poisonous is removed. In this experiment, the tubers are needed to blend as powder form before inserting into machine basket. The user is need to push the START button on machine controller for switching the water pump ON by then creating turbulence wave of water in machine tank. The water will stop automatically by triggering the outlet solenoid valve. The powders of tubers are washed for 10 minutes while 1 liter of contaminated water due toxin mixture is flowing out. At this time, the controller will automatically triggered inlet solenoid valve and the new water will flow in machine tank until achieve the desire level that which determined by ultra sonic sensor. This process will repeated for 7 h and the positive result is achieved and shows it significant according to the several parameters of biological character of pH, temperature, dissolve oxygen, turbidity, conductivity and fish survival rate or time. From that parameter, it also shows the positive result which is near or same with control water and assuming was made that the toxin is fully removed when the pH of DH powder is near with control water. For control water, the pH is about 5.3 while water from this experiment process is 6.0 and before run the machine the pH of contaminated water is about 3.8 which are too acid. This automated machine can save time for removing toxicity from DH compared with a traditional method while less observation of the user.

Key word: Automated removal machine, alkaloid, controller, automation, biological sciences

INTRODUCTION

The evidence of the Almighty of Allah could be seen via His creations such as trees, mountains, animals and the earth. The importance of agriculture for mankind is seen in Al-Quran where eighty three verse were mentioned about it relation for the guidance and necessity of the mankind (Ishak *et al.*, 2011b). For food agriculture processing, the alkaloid removal system is a machine that used to remove the dioscorine by water solvent which consists of several electronic components and automation (Syazili *et al.*, 2013). Prior to plantation, processing the fruits and vegetables are washed and rinsed by means of flumes, soak tanks, water sprays, flotation chambers, or any combination detergents, ultrasonic and automation techniques are also being tested for increased quality and production efficiency (Ishak *et al.*, 2011a; Razali *et al.*, 2012). With the increasing the vibration intensity, the tuber adhesion decrease and they begin to loose the contact with the vibrating working chamber, potato loosening and intensive circulation take place, it favor qualitative washing (Al-Katary *et al.*, 2010).

Turbidity is a biological possession of fluid that causes light to be spotted rather than transmitted in line through the fluid (Kumoro *et al.*, 2011). For this experiment, after two manual machines were built and found that the machines need to operate as standalone totally (Ssomad *et al.*, 2012). That makes our developed automatic machine more efficient and systematic for removing alkaloid toxic from DH. Some construction on the parts of manual machine was done and successfully operated. The system is running using the LEGO controller embedded have microcontroller and modified cable been modified to suit with the system.

MATERIALS AND METHODS

There are many part have to added in effort to make the machine run automatically. The main part should be focused on agriculture mechanization is the controller and automation system (Razali *et al.*, 2010; Razali *et al.*, 2011a, 2011b; Ishak *et al.*, 2011b). The controller used in this project is brand name of LEGO NXT Intelligent Controller. This controller is easy to use and came with a few sensors

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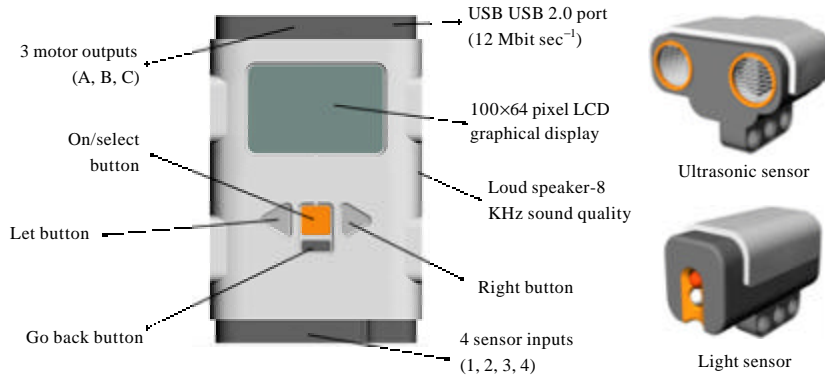
Fig. 1: LEGO NXT intelligent controller and sensor used for development of automatic alkaloid removal system
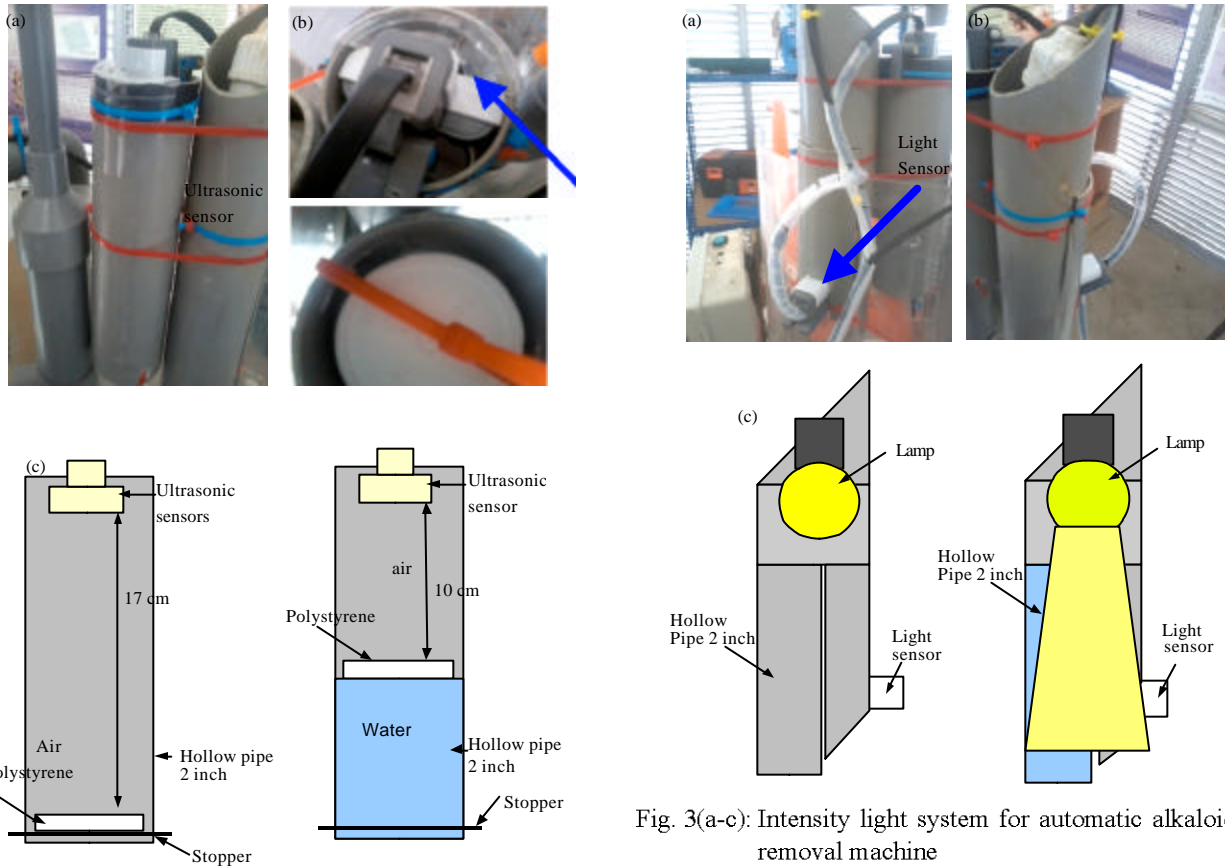

Fig. 2(a-c): The algorithm process on water level detection system

Fig. 3(a-c): Intensity light system for automatic alkaloid removal machine

that can be used together in this machine Razali *et al.* (2011a). Figure 1 shows the controller and sensors. The sensors used are ultrasonic and light sensor. The ultrasonic sensor used for water level while light sensor for record the intensity light of the water. Figure 2 was shown the water level system, the ultrasonic was used as the sensor to send the signal to controller to open and close the solenoid valves. The concept used is measuring the distance between polystyrene. When the level of water increases, the polystyrene also move and floated together and triggering to the sensor. Figure 3 shows the
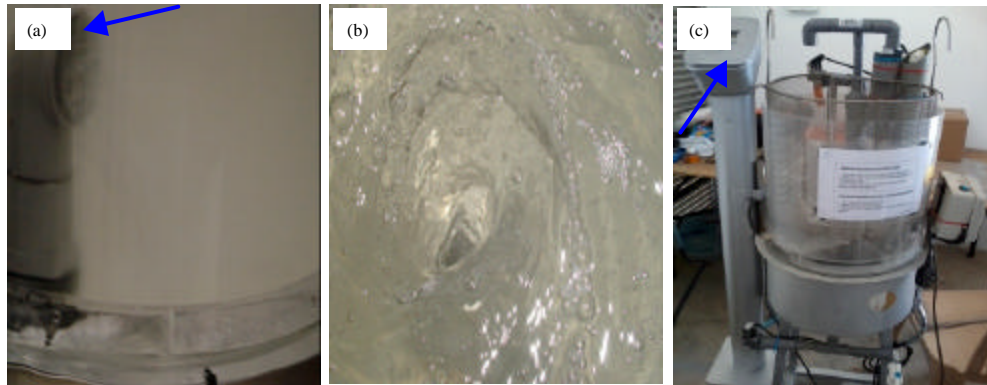
Fig. 4(a-c): Prototype of the automatic alkaloid removal system, (a) Pipe for creating turbulence, (b) Circulation of contaminated water and (c) Our developed prototype and controller

Fig. 5: Machine basket with fabric filter and the bubbles alkaloid during machine operation

light sensor that used to measure the intensity of the light in the water of tank. The special casing was designed to cover the sensor and avoid the other light affected. The lamp was mounting together for give the stable lighting in the hollow pipe. The sensor read the intensity of contaminated water automatically and record in the memory of controller. Figure 4 shows the equipment that used air lift submersible pump of multi system pond pump to produce water circulation. This pump produce 230 watt of power, 7.0 meter of maximum high and 16000 L h of flow rate. Inside the transparent container, an input pipe was placed at the bottom to produce spin type of water circulation. The air flow from this pump can make movement of slices tuber of D.H circulates around the system and vortex water circulation moved the contaminated water flowing up and down. The tubers are washed by using replacement of new water to remove the dioscorine alkaloid. The tubers are sliced and blended to form as powder.

RESULT AND DISCUSSION

Figure 5 show the blended tubers when pouring into machine basket. The maximum tubers can wash is about 2 kg. Figure 5 also was show the alkaloid that removed during experiment. At the operating hour (h) of 1 to 3, there are a lot of alkaloids burble formed. At operating hour of 5 to 7, the forming of alkaloid burble was decrease. We are decided that tuber is free from the alkaloid when there are no bubbles around. After 7 h, the waste water was test to the fish survival. If the fish live that mean the alkaloid form blended tuber was totally removed (Razali *et al.*, 2011a). Table 1 was show the result for 60 liters of water used to wash the 2 kg tubers. The result include the value of pH, temperature, dissolve oxygen, turbidity, conductivity and fish survival rate or life span. All the result was checked by pH Sensor.

As the conclusion, after 7 h the machine is run for removing the toxin of alkaloid, the positive result is shown as in Fig. 6, according to the several parameters such as

Table 1: Result for 60 liter of water waste

|	Liter	pH	Cond. (ms cm^{-1})	Turbidity	Do (mg L^{-1})	Temp. (°C)	Salinity (%)	Intensity	Survival rate
0	0	5.3	0.6	18	0	27	0	53	360
1	1	3.8	7.2	18	-0.1	27	0.4	58	24
2	4	3.8	7.7	18	-0.1	27	0.4	56	0
3	7	3.7	8.5	18	-0.1	27	0.5	50	23
4	10	3.7	8.6	99	-0.1	27	0.5	52	37
5	13	3.7	8.5	99	-0.1	27	0.5	47	25
6	16	3.7	8.4	99	-0.1	27	0.5	46	24
7	19	3.7	8.4	99	-0.1	27	0.4	42	24
8	22	3.8	7.2	99	-0.1	27	0.4	0	32
9	25	3.8	6.5	99	-0.1	27	0.3	0	0
10	28	3.8	5.9	99	-0.1	27	0.3	0	0
11	31	3.9	5.5	99	-0.1	27	0.3	0	0
12	34	3.9	5	99	-0.1	27	0.3	48	0
13	37	3.9	4.6	99	0	27	0.2	51	0
14	40	4.0	4.1	20	0	27	0.2	48	360
15	43	4.0	3.8	19	0	27	0.2	47	360
16	46	4.1	3.3	99	0	27	0.2	45	360
17	49	4.3	2.2	17	0	27	0.1	50	360
18	52	4.5	1.7	99	0	27	0.1	0	360
19	55	4.7	1.2	99	0	27	0.1	0	360
20	58	5.0	0.8	10	0	27	0.1	48	360
21	60	6.0	0.12	18	0	27	0	51	360
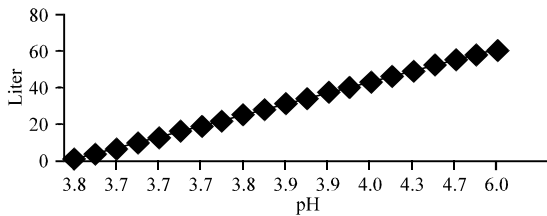
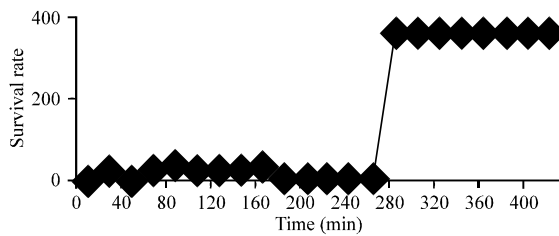Fig. 6: Processed water quantity vs. value of pH

Fig. 7: Survival rate of fish vs. time in min

pH, temperature, dissolve oxygen, turbidity, conductivity and fish survival rate or time. From that parameter, it also shows the positive result which is near or same with control water. From Fig. 7, we assume the toxin is removing when the pH of *Dioscorea hispida Dennts* is near with control water that is tap water after the machine is run for 7 h. For control, the pH is about 5.3 and for the *Dioscorea hispida Dennts* waste water is 6.0, before run the machine the pH is about 3.8 that are acid. The fish, *Cyprinus carpio* is survived more than 6 h. From the experiment, at minute 280 or 4 h and 40 min the fish start show the survival rate.

This system was further improved with manual machine that done previously developed by Razali *et al.* (2011b) which also the best inshaAllah, when comparing with effective method that claimed by Kumoro *et al.* (2011). It due to our developed machine can work as stand alone machine which is the farmer can put at home for their daily food processing (Ssomad *et al.*, 2012). It also stated that the duration for removing alkaloid from tubers is require just only 6 to 7 h which compared with manual processing that require 24 h .

CONCLUSION

Automation and mechanization technology in biological science and plantation industry is still new and still under research and development. The application of computer, mechatronics and machines for agricultural production has been one of the outstanding developments in Malaysian agriculture. This paper describes on the recent research at Malaysian public university on the uses of computer and electronics towards machines for the agricultural operations. In conclusion, studies on electronic and computer-assisted devices leading to automation for application in agriculture had to be perpetually carried out.

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REFERENCES

Al-Katary, H.S., H.A. El-Mawla, M.A. Osman and A.M. Ahmed, 2010. Washing water turbidity as indicator to fruit and vegetable washer efficiency. Misr J. Agric. Eng., 27: 662-675.

Ishak, W.I.W., R.M. Hudzari, S.M. Nasir, I. Napsiah and M.S. Abdul Rashid, 2011a. Videogrammetry application for stereo vision bio-production harvester. Trends Applied Sci. Res., 6: 495-506.

Ishak, W.I.W., T.M. Yin and R.M. Hudzari, 2011b. Development of control program for plant growth parameter analysis in lowland tropical greenhouse. J. Applied Sci., 11: 592-598.

Kumoro, A.C., D.S. Retnowati and C.S. Budiyati, 2011. Removal of cyanides from gadung dioscorea hispida dennst tuber chips using leaching and steaming techniques. J. Applied Sci. Res., 7: 2140-2146.

Razali, M.H.H., W.I.W. Ismail and M.M. Noorman, 2010. Parameter acceptance for software development of oil palm fruit ripeness prediction. J. Software Eng., 4: 244-256.

Razali, M.H.H., W.I.W. Ismail, A.R. Ramli, M.N. Sulaiman and M.H. Harun, 2011a. Prediction model for estimating optimum harvesting time of oil palm fresh fruit bunches. J. Food Agric. Environ., 9: 570-575.

Razali, M.H.H., M.A.H.A. Ssomad, Y.M. Rizuwan, M.N.N. Asimi and A.B. Abdullah, 2011b. Development of automatic alkaloid removal system for *Dioscorea hispida*. Frontiers Sci., 1: 16-20.

Razali, M.H.H., N.A.M. Noor, N.I. Othman and H.I. Hamdan, 2012. Mechatronic application for agriculture mechanization analysis and education. Software Eng., 2: 106-111.

Ssomad, M.A.H.A., R.M. Hudzari, M.N.A. Noordin, S.J. Abdullah, S.M. Sapuan and S. Hassan, 2012. Simulation and analysis of force requirement for harvesting *Dioscorea hispida* tubers. Adv. Res. Mater., 626: 459-463.

Syazili, R., R.M. Hudzari, M. Kamarul'Ain, A.B.C. Abdullah, M.N.N. Asimi and M.A.H.A. Ssomad, 2013. Development of rapid detection device for determination of alkaloid level in *Dioscorea hispida*. Adv. Res. Mater., 626: 464-469.