Adjustable and Automatic Flush Toilet

Yair Wiseman

Computer Science Department, Israel, wiseman@cs.biu.ac.il

ABSTRACT

In large areas in our planet, water is a limited resource and with the population growth, there will be a necessity for even more water. One of the significant water consuming facilities is the flush toilet. We suggest an automatically adjusting of the water amount released in each flush by a facility capable of analyzing the content of the toilet bowl and accordingly making a decision how much water should be released in order to wash out this content. Unlike the common flush toilets, the decision about the amount of water will not be between just two options and furthermore this decision will be taken automatically.

KEYWORDS

Toilet, Water Saving, Discrete Cosine Transform, JPEG.

1 Introduction

Using the toilet is an everyday event; however, no much progress has been noticed during last years. Many of last year researches have been aiming at special toilets for disableds or elderly people [1,2,3] which is obviously very important; however, there is still many conventional toilet elements to be improved.

One of the common toilet elements that can be improved is the dual flush toilet that lets the users to decide on the amount of the flushed water with the intention of saving water; however, these dual flush toilets have two significant disadvantages:

Most of them let the users to choose only between two amounts of water.

- The decision of the amount of water is manually done by the user and is not done automatically by the toilet mechanism.
- The dual flush facility is usually operated by two flush pushbuttons where pressing one pushbutton releases more water; whereas pressing the other pushbutton releases less water.

There are also flush facilities controlled by pulling the flush handle down and up, where pulling the flush handle down starts the flush and pulling the flush handle up stops the flush. This method lets the user to choose between more amounts of water; however, the choice of the amount of water is still done manually by the user.On the other hand, there are flush facilities that identify a presence of a person in a restroom and when this person leaves the restroom the flush facility automatically will release water [4]; however, there is no automatic decision based on what can be seen inside toilet bowl so as to decide about the suitable amount of water.

In this paper we suggest an improved toilet facility that can automatically decide on the suitable amount of water based on what can be seen by a simple digital camera in the toilet bowl.

In order to avoid ethical issues to use a camera inside a toilet bowl, the camera will not have any kind of memory, so the camera will be actually an enhanced mirror with no ability of saving or communicating.

2 Smart sensing Toilets

Using the services of a simple digital camera can be effective to detect the quantity of waste within the toilet bowl and accordingly the toilet facility can decide on the suitable amount of water that should be used in order to flush this waste.

Nowadays, the most popular format for image compression of digital camera is JPEG [5,6,7]. Actually, JPEG is not just popular in digital cameras; but also the most popular format for image compression in the web and many other applications [8].

The JPEG format is prevalent because of several benefits like the ability to decoded parts of the image in parallel [9], the well documented open code that makes it uncomplicated to adjust the format to specific implementations [10] and the suitability for straightforward and uncomplicated hardware implementation [11,12].

The main reason for image compression is because the network is too loaded and too slow; hence sending a smaller image can use smaller bandwidth and consequently will be transmitted faster and will produce a smaller load on the network. Also compressing images can lighten the memory pressure in the device [13].

Even though the compression procedure of JPEG loses some data, this loss is unnoticeable. JPEG prefers to lose this data in order to be able to significantly compress the image size.

The algorithm of JPEG is designed to mainly take in account the way a human eye catches sight of objects. JPEG removes substantial parts of the data that are unnoticeable for human eyes from the image. Human eyes are mostly aware to changes in their sight and as will be explained below the suggested application is mostly focused in the changes within the image, the information that JPEG generates will be very suitable.

In addition, using the output of JPEG algorithm will let us use a standard digital camera without any necessity to adjust it for this specific implementation before the use. This will make this facility simpler to produce and will also lower the price of this facility.

So in our implementation the toilet facility will straightforwardly use the compressed image in order to decide on the suitable amount of water, rather than decompressing the image before the use.

3 Detection the quantity of waste within the toilet bowl

The JPEG format is an eminent standard for image compression. JPEG compresses better images that do not have sharp differences like pictures of meadows. The JPEG format is well documented [14,15,16].

JPEG supports both color images and grayscale images; however, the grayscale images are rarely used and we will also use color images.

In the first step of JPEG algorithm, the well-known DCT algorithm [17] is employed by the JPEG algorithm to transform images from the sample space to the frequency space. If the image is actually without sharp differences as JPEG supposes, almost all the coefficients will be on the interval (-0.5, 0.5).

The second step of JPEG is called quantization. In this step the coefficients are divided by some constants and next they are rounded to the closest integer. Consequently, coefficients in the interval (-0.5, 0.5) are rounded to zero and when the divider constant is greater than one, the chances that these coefficients will be rounded to zero are even higher. Therefore, when there are no sharp differences in the image, most of the coefficients will be zero and the JPEG compressed image size will be very small.

If there are shape differences in the image many coefficients will not be rounded to zero and the JPEG compressed image size will be larger than image in the same size without shape differences.

The presence or the absence of sharp differences in an image influence the image file size in this way: JPEG splits the JPEG image to blocks of 8X8 pixels of Y, U and V components [18]. These blocks are arranged from left to right in a line by line order within the JPEG compressed file [19,20]. Each block is transformed by the DCT algorithm and if there are sharp differences within an 8X8 block, this 8X8 block will be compressed less efficiently. If many blocks are compressed less efficiently because of many sharp differences within the blocks, the entire size of the JPEG compressed image will be considerably large.

Giving these features of JPEG, the toilet facility compares a picture of an empty toilet bowl vs. a toilet bowl containing some waste. The main issue will be to realize the amount of the waste within the toilet bowl and accordingly the toilet facility is capable to decide about the amount of the water needed to flush the waste.

Formally, there is no legal connection between JPEG and MPEG; however, both JPEG and MPEG use almost the same methods and are very similar [21]. The main difference is that JPEG offers a still image compression whereas MPEG offers a movie compression.

MPEG defines P-frame as "Predicted Frame". Such a frame does not save the raw data, but rather it saves the changes in the image from a previous frame and as a result the unchanged data is not saved.

The original intention of P-frame is saving space, because subsequent frames tend to be similar to their previous frames in many cases; however, for our implementation there is a different benefit for P-frames – Sometimes there is a light on the water in the toilet bowl like in Figure 1. This can be misinterpreted by the toilet facility as waste that should be flushed. So, taking the P-frame can validate that such a misinterpretation will not happen, because the light will exist in the previous frame as well; however, turning on or turning off the light in the rest room indeed sometimes caused the toilet facility to release water.

Figure 1. Light reflection in toilet bowl

The toilet facility algorithm uses the MPEG/JPEG compression to achieve the P-frame. After that, the algorithm analyzes the compressed file size of this P-frame. According to the entire size of the P-frame, the toilet facility will decide on the suitable amount of water.

JPEG is a very prevalent format that suitable for our implementation and is commonly used. There may perhaps be other suitable formats, but employing uncommon formats will have need of using an standard equipment which is undesirable.

Figure 2 is an example of how JPEG will manage a block containing a sharp difference vs. a block with no difference. The image in Figure 2 was compressed by the standard baseline grayscale JPEG format with a quality of 75%. The image is in a size of 1000X1000 pixels. Most of the pixels are white with the exception of the black rectangle that its pixels are black. The values of the 8X8 JPEG block containing the black rectangle upper left part are written in Table 1. It should be noted that the rectangle borderlines are not aligned to the 8X8 JPEG blocks.

The DCT process saves for each 8X8 block the average value of the pixels. This average is called DC. JPEG saves the DC values as the difference between the current DC value and the previous DC value [22,23]. When a block contains only pixels of one color, obviously this color will be the average value.

In the image of figure 2, there will not be a difference in the DC values in most of the cases, so they will be zero. Just in the JPEG blocks near the boundaries of the rectangle, the DC value will be greater than zero. Zero values are compressed by JPEG algorithm into a smaller sequence of bits than other greater DC values.

As was mentioned above, the other values of 8X8 JPEG block will be compressed more efficiently if the sampling values are very similar. In the case of Figure 2, the values are the same so the 8X8 JPEG blocks containing equal pixels will be managed very efficiently and will be actually encoded into only six bits: 0,0,1,0,1,0.

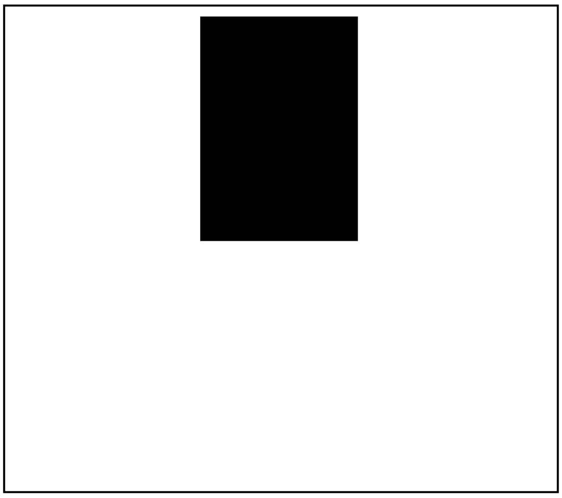

Figure 2. Synthetic image showing how JPEG handle differences

The six bits sequence starts with 00 indicates there is no difference between the DC value of this 8X8 block and the DC value of the previous 8X8 block. The other values are all zeros, so JPEG algorithm puts 1010 indicates an end of the block (EOB).

-12	18	-8	-2	3	-1	-1	1
22	-25	8	2	-3	0	1	-1
-18	20	-7	-2	2	0	-1	1
16	14	4	1	-1	0	1	1
-11	10	-2	-1	0	-1	-1	0
6	-5	1	-3	0	0	0	0
-2	2	-1	0	0	0	0	0
1	-1	0	0	0	0	0	0

Table 1. JPEG compression for the block with the substantial change.

Conversely, a block containing abundant of differences in the pixels' colors will be transformed by the DCT algorithm into a wide range of frequency values. For example, Table 1 shows the DCT output of the 8X8 JPEG block containing the black rectangle upper left part of Figure 2. JPEG algorithm will compress the coefficients of Table 1 into as many as 243 bits.

The distinction between 243 bits required for the 8X8 block containing the rectangle corner and the only six bits required for the smooth 8X8 blocks is clearly noticeable. So, if an image of the toilet bowl contains a large amount of waste, there will be many blocks with differences and as a result, the image size will be larger.

JPEG standard specifies a quality factor. Based on this factor two quantization tables are generated: one quantization table for the luminance (brightness) information and a second quantization table for the chrominance (color) information. Applications that comply with IJG (Independent JPEG Group) will use quantization tables specified by IJG; however, there are other applications that do not comply with IJG and use other quantization tables.

In toilet facility camera, we use the standard IJG quantization tables and the highest quality factor (100%) has been selected with the purpose of obtaining the best distinguishableness. In fact, quality factor of 100% in IJG specifies that the entire quantization table is filled with ones i.e. all the frequency coefficients in the JPEG blocks will not be divided.

4 Experiments

We employed an SQ11 Spy Hidden Mini Camera [24] with lens size of 3.6mm, Camera resolution of 1.2MP and Decode Format has been H.264 [25].

The amount of the released water in one flush was according to the size of the compress image. Specifically it was set to:

(1) $amount = \arctan((x-300)/140)/\pi * 8 + 2$

where x is the size of the JPEG compressed image in Kbytes and the amount is in liters. The graph of this function is shown in Figure 3.

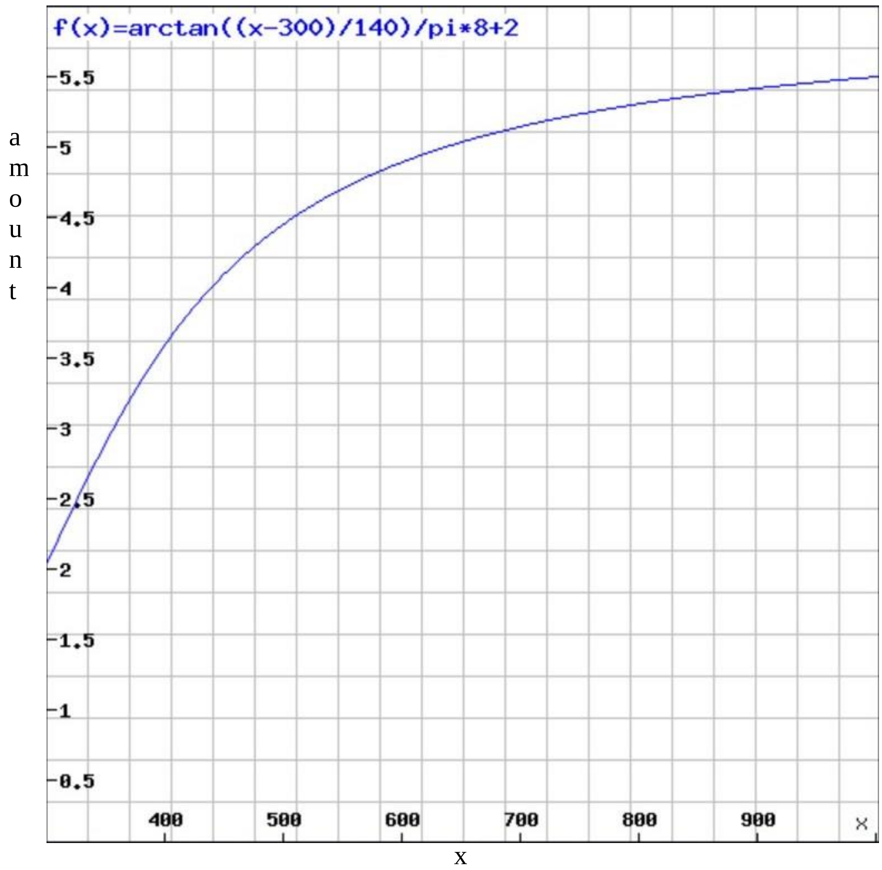

Figure 3. Graph of the amount of water

Clearly, smooth blocks and blocks with sharp differences like the blocks in Figure 2 infrequently occur in real images of toilet bowls; however, the toilet facility has still succeeded in most of the cases to figure out the amount of the waste within the toilet bowl.

When the size of pictures is less than 300KB, it means the toilet bowl is empty. Usually the size of an empty bowl is even 100KB, but some slight occurrences can slightly increase it, like a strong door shutting that can make some small ripples and little foams.

The minimum amount of water in one water release is 2 liters. Smaller amount does not succeed to flush even small objects, so if the toilet facility decides on flush, no less than 2 liters will be released.

The maximum image size that we had observed was 1068KB. The image is not shown here, because it is not nice-looking; however, it contains feces and the dark color of the feces is very different from the white toilet paper; therefore, many blocks have been compressed into a larger sequence of bits and the result was a large JPEG file size which indicates a requirement for the toilet facility to release a larger amount of water.

Some toilet papers have some drawings like in Figure 4. This drawing usually increases the JPEG file size slightly; however, as a rule, when a paper toilet is used, the toilet bowl content should be flushed and the addition to the water amount is quite slight.

Figure 4. Toilet paper with drawing

When the toilet bowl is full with urine, the JPEG file size will be also small, because a smooth yellow image has no difference in the colors and as was explained above, JPEG file size is determined by the differences in the original image; therefore, when there is almost no difference, the JPEG file size will be small and no water will be released to wash out the toilet bowl.

However, while the urine is entering the bowl, there will be some ripples and foams that will increase the differences in the original image and hence the JPEG file size will be larger, so as a result the toilet facility will detect the ripples and the foams and will release some water. This amount of water will be less than the amount of water in a case of feces, but this is just what is required in a case of flushing a toilet bowl with urine.

5 False alarms

Foams made a difficulty for the toilet facility. If the quantity of the foams is too sizeable, differences in the JPEG blocks will be detected and the image size will be larger; therefore, the toilet facility will decide to flush for no good reason.

In point of fact, false alarms are an infamous problem in many automatic sensing facilities and the toilet facility is no exception. A human can straightforwardly observe that foams in the toilet does not require a flush; however, the toilet facility just checks the compressed file size and therefore it may possibly be wide of the mark in its conclusion and flush in vain.

The foams are almost always different in their sizes and shapes. Therefore, even though we take the P-frame which means the differences between the frames, the 8X8 JPEG blocks will not contain zero or almost zero values, but rather higher values and consequently JPEG will compress them into a larger file.

Even so, this misinterpretation of the toilet facility is actually not so harmful, because after a small number of flushes, the detergents will be washed out and the differences between the P-frames will be very small, so the file size will be also small enough to cause the toilet facility stopping to release water.

Figure 5. Foam in a toilet bowl

This in actual fact is depended in the detergent type. Some detergents make more foams than others, so choosing appropriate detergents can be helpful for the toilet facility. A toilet bowl using an inappropriate detergent can be seen in Figure 5.

There are also some detergents that make the water blue and because we take the P-frame and there might be shade differences, between the successive frames, the values of the 8X8 JPEG block will not be zero; however, since the entire 8X8 JPEG block has the same color, JPEG will be able to compress such block into a small files, so no flush will be done.

6 Conclusions and Future work

The use of sensors in rest rooms is longstanding [26,27]; however, the interpreting of the information obtained by the sensors has been minimal and accordingly the functionality has been basic and often does not provide the best possible operation.

In this paper we employ JPEG that makes use of DCT. The JPEG blocks will be compressed into a shorter sequence of bits by DCT if they do not contain sharp differences. JPEG Blocks containing sharp differences will be compressed into a much longer sequence of bits. For that reason, the entire file size of a JPEG image of a toilet bowl can indicate how much waste exists in it.

According to the gauged amount of waste in the toilet bowl, the toilet facility will be able to decide about the most suitable amount of water. So, instead of choosing between just two options by the user, the new facility is able to choose between unlimited options and the choice is done by the facility itself.

REFERENCES

[1] T. Pilissy, A. Tóth, G. Fazekas, A. Sobják, R. Rosenthal, T. Lüftenegger, P. Panek and P. Mayer, "Towards a situation-and-user-aware multi-modal motorized toilet system to assist older adults

with disabilities: a user requirements study", In 2017 IEEE International Conference on Rehabilitation Robotics (ICORR), pp. 959-964, 2017.
[2] P. Panek and P. Mayer, "Initial Interaction Concept for a Robotic Toilet System", In ACM Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction, pp. 249-250, 2017.
[3] J. Molenbroek, F. Maria, J. Mantas and R. De Bruin, "A Friendly Rest Room: Developing toilets of the future for disabled and elderly people", Assistive Technology Research Series, volume 27, 2011.
[4] M. Dodge and R. Kitchin, "Towards Touch-Free Spaces: Sensors, Software and the Automatic Production of Shared Public Toilets", Touching Space, Placing Touch, Edited by M. Paterson and M. Dodge, pp. 191-210, 2016.
[5] Y. Wiseman, "Take a Picture of Your Tire!", Proc. IEEE Conference on Vehicular Electronics and Safety (IEEE ICVES-2010) Qingdao, ShanDong, China, pp. 151-156, 2010.
[6] Y. Wiseman, "The Effectiveness of JPEG Images Produced By a Standard Digital Camera to Detect Damaged Tyres", World Review of Intermodal Transportation Research, Vol. 4(1), pp. 23-36, 2013.
[7] Y. Wiseman, "Camera That Takes Pictures of Aircraft and Ground Vehicle Tires Can Save Lives", Journal of Electronic Imaging, Vol. 22(4), 041104, 2013.
[8] L. Yuan and T. Ebrahimi, "Image transmorphing with JPEG", In 2015 IEEE International Conference on Image Processing (ICIP), pp. 3956-3960, 2015.
[9] S. T. Klein and Y. Wiseman, "Parallel Huffman Decoding with Applications to JPEG Files", The Computer Journal, Oxford University Press, Swindon, UK, Vol. 46(5), pp. 487-497, 2003.
[10] Y. Wiseman, "Burrows-Wheeler Based JPEG", Data Science Journal, Vol. 6, pp. 19-27, 2007.
[11] Y. Wiseman, "A Pipeline Chip for Quasi Arithmetic Coding", IEICE Journal - Trans. Fundamentals, Tokyo, Japan, Vol. E84-A No.4, pp. 1034-1041, 2001.
[12] R. Ben Yehuda and Y. Wiseman, "The Offline Scheduler for Embedded Vehicular Systems", International Journal of Vehicle Information and Communication Systems, Vol. 3(1), pp. 44-57, 2013.
[13] M. Reuven and Y. Wiseman, "Medium-term scheduler as a solution for the thrashing effect", The Computer Journal, Vol. 49(3), pp. 297-309, 2006.
[14] Information Technology – Digital Compression and Coding of Continuous-Tone Still Images Requirements and Guidelines – International Standard ISO/IEC 10918-1, 1993.
[15] G. K. Wallace, The JPEG Still Picture Compression Standard Communication of the ACM 34, pp. 3-44, 1991.
[16] Y. Wiseman, "The still image lossy compression standard - JPEG", Encyclopedia of Information and Science Technology, IGI Global, Third Edition, Vol. 1, Chapter 28, pp. 295-305, 2014.
[17] R. Shan, C. Wang, W. Huang and X. Zhou, "DCT-JPEG Image Coding Based on GPU", International Journal of Hybrid Information Technology, Vol. 8, No. 5, SERSC, pp. 293-302, 2015.
[18] Y. Liu, D. Wang, J. Zhang and X. Chen, "A Fast Fusion Method for Multi-exposure Image in YUV Color Space", In 2018 IEEE 3rd Advanced Information Technology, Electronic and Automation Control Conference (IAEAC), pp. 1685-1689, 2018.
[19] Y. Wiseman, "Enhancement of JPEG Compression for GPS Images", International Journal of Multimedia and Ubiquitous Engineering, Vol. 10(7), pp. 255-264, 2015.
[20] Y. Wiseman, "Improved JPEG based GPS picture compression", Advanced Science and Technology Letters, Vol. 85, pp. 59-63, 2015.
[21] T. Strutz, "Bilddatenkompression: Grundlagen, Codierung, MPEG, JPEG", Springer-Verlag, 2013.
[22] Y. Wiseman, "Alleviation of JPEG Inaccuracy Appearance", International Journal of Multimedia and Ubiquitous Engineering, Vol. 11(3), pp. 133-142, 2016.
[23] Y. Wiseman, "Diminution of JPEG Error Effects", The Seventh International Conference on Future Generation Information Technology, Vol. 117, pp. 6-9, 2015.
[24] User Manual, "SQ11 mini DV. User Guide", available at: https://www.ordinoscope.net/images/7/78/SQ11_manual_ord-info.pdf , 2018.
[25] A Puri, X. Chen and A. Luthra, "Video coding using the H. 264/MPEG-4 AVC compression standard", Signal processing: Image communication, Vol 19, No. 9, pp. 793-849, 2004.
[26] Barrett, John T. "Automatic toilet flushing system." U.S. Patent 4,756,031, Issued in July 12, 1988.
[27] Nortier, Richard A. "Toilet room sensor assembly." U.S. Patent 5,548,119, Issued in August 20, 1996.

[28] R. B. Yehezkael, Y. Wiseman, H. G. Mendelbaum and I. L. Gordin, "Experiments in Separating Computational Algorithm from Program Distribution and Communication", LNCS of Springer Verlag Vol. 1947, pp. 268-278, 2001.
[29] E. Fredj and Y. Wiseman, "An O(n) Algorithm for Edge Detection in Photos Compressed by JPEG Format", Proc. IASTED International Conference on Signal and Image Processing SIP-2001, Honolulu, Hawaii, pp. 304-308, 2001.
[30] Y. Wiseman and E. Fredj, "Contour Extraction of Compressed JPEG Images", ACM - Journal of Graphic Tools, Vol. 6(3), pp. 37-43, 2001.
[31] Y. Wiseman, K. Schwan and P. Widener, "Efficient End to End Data Exchange Using Configurable Compression", Proc. The 24th IEEE Conference on Distributed Computing Systems (ICDCS 2004), Tokyo, Japan, pp. 228-235, 2004.
[32] Y. Wiseman, "ARC Based SuperPaging", Operating Systems Review, Vol. 39(2), pp. 74-78, 2005.
[33] Y. Wiseman, "Advanced Non-Distributed Operating Systems Course", ACM - Computer Science Education, Vol. 37(2), pp. 65-69, 2005.
[34] M. Reuven and Y. Wiseman, "Reducing the Thrashing Effect Using Bin Packing", Proc. IASTED Modeling, Simulation, and Optimization Conference, MSO-2005, Oranjestad, Aruba, pp. 5-10, 2005.
[35] Y. Wiseman, "The Relative Efficiency of LZW and LZSS", Data Science Journal, Vol. 6, pp. 1-6, 2007.
[36] Y. Wiseman and I. Gefner, "Conjugation Based Compression for Hebrew Texts", ACM Transactions on Asian Language Information Processing, Vol .6(1), article no. 4, 2007.
[37] I. Grinberg and Y. Wiseman, "Scalable Parallel Collision Detection Simulation", Proc. Signal and Image Processing (SIP-2007), Honolulu, Hawaii, pp. 380-385, 2007.
[38] Y. Wiseman, "ASOSI: Asymmetric Operating System Infrastructure", Proc. 21st Conference on Parallel and Distributed Computing and Communication Systems, (PDCCS 2008), New Orleans, Louisiana, pp. 193-198, 2008.
[39] Y. Wiseman, J. Isaacson and E. Lubovsky, "Eliminating the Threat of Kernel Stack Overflows", Proc. IEEE Conference on Information Reuse and Integration (IEEE IRI-2008), Las Vegas, Nevada, pp. 116-121, 2008.
[40] M. Itshak and Y. Wiseman, "AMSQM: Adaptive Multiple SuperPage Queue Management", Proc. IEEE Conference on Information Reuse and Integration (IEEE IRI-2008), Las Vegas, Nevada, pp. 52-57, 2008.
[41] P. Weisberg and Y. Wiseman, "Using 4KB Page Size for Virtual Memory is Obsolete", Proc. IEEE Conference on Information Reuse and Integration (IEEE IRI-2009), Las Vegas, Nevada, pp. 262-265, 2009.
[42] R. Ben Yehuda and Y. Wiseman, "The Offline Scheduler for Embedded Transportation Systems", Proc. IEEE Conference on Industrial Electronics (IEEE ICIT-2011), Auburn, Alabama, pp. 449-454, 2011.
[43] D. Livshits and Y. Wiseman, "Cache Based Dynamic Memory Management For GPS", Proc. IEEE Conference on Industrial Electronics (IEEE ICIT-2011), Auburn, Alabama, pp. 441-446, 2011.
[44] Y. Wiseman and P. Weisberg, "Economical Memory Management for Avionics Systems", IEEE/AIAA 31st Digital Avionics Systems Conference (DASC), 2013.
[45] Y. Wiseman and A. Barkai, "Diminishing Flight Data Recorder Size", IEEE/AIAA 31st Digital Avionics Systems Conference (DASC), 2013.
[46] D. Livshits and Y. Wiseman, "The Next Generation GPS Memory Management", International Journal of Vehicle Information and Communication Systems, Vol. 3(1), pp. 58-70, 2013.
[47] Y. Wiseman, "Fuselage Damage Locator System", Advanced Science and Technology Letters, Vol. 37, pp. 1-4, 2013.
[48] I. Grinberg and Y. Wiseman, "Scalable Parallel Simulator for Vehicular Collision Detection", International Journal of Vehicle Systems Modelling and Testing, Vol. 8(2), pp. 119-144, 2013.
[49] Y. Wiseman and A. Barkai, "Smaller Flight Data Recorders", Journal of Aviation Technology and Engineering, Vol. 2(2), pp. 45-55, 2013.
[50] P. Weisberg and Y. Wiseman, "Efficient Memory Control for Avionics and Embedded Systems", International Journal of Embedded Systems, Vol. 5(4), pp. 225-238, 2013.
[51] Y. Wiseman, "Steganography Based Seaport Security Communication System", Advanced Science and Technology Letters, Vol. 46, pp. 302-306, 2014.
[52] Y. Wiseman, "Device for Detection of Fuselage Defective Parts", Information Journal, Tokyo, Japan, Vol. 17(9(A)), pp. 4189-4194, 2014.

[53] P. Weisberg, Y. Wiseman and J. Isaacson, "Enhancing Transportation System Networks Reliability by Securer Operating System", Open Journal of Information Security and Applications, Vol. 1(1), pp. 24-33, 2014.
[54] Y. Wiseman, "Noise Abatement at Ben-Gurion International Airport", Advanced Science and Technology Letters, Vol. 67, pp. 84-87, 2014.
[55] Y. Wiseman, "Protecting Seaport Communication System by Steganography Based Procedures", International Journal of Security and Its Applications, Sandy Bay, Tasmania, Australia, Vol. 8(4), pp. 25-36, 2014.
[56] Y. Wiseman, "Noise Abatement Solutions for Ben-Gurion International Airport", International Journal of U- & E-Service, Science & Technology, Vol. 7(6), pp. 265-272, 2014.
[57] P. Weisberg and Y. Wiseman, "Virtual Memory Systems Should Use Larger Pages rather than the Traditional 4KB Pages", International Journal of Hybrid Information Technology, Vol. 8(8), pp. 57-68, 2015.
[58] P. Weisberg and Y. Wiseman, "Virtual Memory Systems Should use Larger Pages", Advanced Science and Technology Letters, Vol. 106, pp. 1-4, 2015.
[59] Y. Wiseman and Y. Giat, "Red Sea and Mediterranean Sea Land Bridge via Eilat", World Review of Intermodal Transportation Research, Vol. 5(4), pp. 353-368, 2015.
[60] Y. Wiseman, "Can Flight Data Recorder Memory Be Stored on the Cloud?", Journal of Aviation Technology and Engineering, Vol. 6(1), 16-24, 2016.
[61] Y. Wiseman and I. Grinberg, "Autonomous Vehicles Should Not Collide Carelessly", Advanced Science and Technology Letters, Vol. 133, pp. 223-228, 2016.
[62] Y. Wiseman and Y. Giat, "Multi-modal passenger security in Israel", Multimodal Security in Passenger and Freight Transportation: Frameworks and Policy Applications, Edward Elgar Publishing Limited, Chapter 16, pp. 246-260, 2016.
[63] Y. Wiseman, "Traffic Light with Inductive Detector Loops and Diverse Time Periods", Contemporary Research Trend of IT Convergence Technology, Vol. 4, pp. 166-170, 2016.
[64] Y. Wiseman, "Unlimited and Protected Memory for Flight Data Recorders", Aircraft Engineering and Aerospace Technology, Vol. 88(6), pp. 866-872, 2016.
[65] Y. Wiseman and I. Grinberg, "When an Inescapable Accident of Autonomous Vehicles is Looming", International Journal of Control and Automation, Vol. 9(6), pp. 297-308, 2016.
[66] Y. Wiseman, "Conceptual Design of Intelligent Traffic Light Controller", International Journal of Control and Automation, Vol. 9(7), pp. 251-262, 2016.
[67] Y. Wiseman, "Compression Scheme for RFID Equipment", Proc. IEEE International Conference on Electro Information Technology (EIT 2016), Grand Forks, North Dakota, USA, pp. 387-392, 2016.
[68] Y. Wiseman and I. Grinberg, "Circumspectly Crash of Autonomous Vehicles", Proc. IEEE International Conference on Electro Information Technology (EIT 2016), Grand Forks, North Dakota, USA, pp. 382-386, 2016.
[69] Y. Wiseman, "Efficient RFID Devices", Proc. The 42nd Annual Conference of IEEE Industrial Electronics Society (IECON 2016), Firenze (Florence), Italy, pp. 4762-4766, 2016.
[70] Y. Wiseman, "Computerized Traffic Congestion Detection System", International Journal of Transportation and Logistics Management, Vol. 1(1), pp. 1-8, 2017.
[71] Y. Wiseman, "Remote Parking for Autonomous Vehicles", International Journal of Hybrid Information Technology, Vol. 10(1), pp. 313-324, 2017.
[72] Y. Wiseman, "Tool for Online Observing of Traffic Congestions", International Journal of Control and Automation, Vol. 10(6), pp. 27-34, 2017.
[73] Y. Wiseman, "Safety Mechanism for SkyTran Tracks", International Journal of Control and Automation, Vol. 10(7), pp. 51-60, 2017.
[74] Y. Wiseman, "Self-Driving Car - A Computer will Park for You", International Journal of Engineering & Technology for Automobile Security, Vol. 1(1), pp. 9-16, 2017.
[75] Y. Wiseman, "Real-Time Monitoring of Traffic Congestions", IEEE International Conference on Electro Information Technology (EIT 2017), Lincoln, Nebraska, USA, pp. 501-505, 2017.
[76] Y. Wiseman, "Automatic Alert System for Worn Out Pipes in Autonomous Vehicles", International Journal of Advanced Science and Technology, Vol. 107, pp. 73-84, 2017.
[77] Y. Wiseman, "Vehicle Identification by OCR, RFID and Bluetooth for Toll Roads", International Journal of Control and Automation, Vol. 11(9), pp. 67-76, 2018.
[78] Y. Wiseman, "Ancillary Ultrasonic Rangefinder for Autonomous Vehicles", International Journal of Security and its Applications, Vol. 12(5), pp. 49-58, 2018.

[79] Y. Wiseman and I. Grinberg, "The Trolley Problem Version of Autonomous Vehicles", The Open Transportation Journal, Vol. 12, pp. 105-113, 2018.
[80] Y. Wiseman, "In an Era of Autonomous Vehicles, Rails are Obsolete", International Journal of Control and Automation, Vol. 11(2), pp. 151-160, 2018.
[81] Y. Wiseman, "Compaction of RFID Devices using Data Compression", IEEE Journal of Radio Frequency Identification, Vol. 1(3), pp. 202-207, 2018.
[82] Y. Wiseman, "Efficient Embedded Computing Component for Anti-Lock Braking System", International Journal of Control and Automation, Vol. 11(12), pp. 1-10, 2018.
[83] Y. Wiseman, "Efficient Embedded Images in Portable Document Format (PDF)", International Journal of Advanced Science and Technology, Vol. 124, pp. 129-138, 2019.
[84] Y. Wiseman, "Autonomous Vehicles", Encyclopedia of Organizational Knowledge, Administration, and Technologies, First Edition, 2019.
[85] Y. Wiseman, "Driverless Cars will Make Rails Obsolete", IEEE Technology and Society, Vol. 38(2), 2019.
[86] Y. Wiseman, "Blaumilch Canal on Ayalon Highway", Daaton, Available online at: http://www.daaton.co.il/Article.aspx , 2015.
[87] M. Dreyfuss and Y. Giat, "Optimal spares allocation to an exchangeable-item repair system with tolerable wait", European Journal of Operational Research 261 (2), pp. 584-594, 2017.
[88] Y. Giat, "The effects of output growth on preventive investment policy", American Journal of Operations Research 3 (06), 474