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Nepros- An Innovated Crystal Necklace

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***Abstract*—**In this paper, we proposed an invention of an accessory into a communication device that will help humans to be connected universally. Generally, this device will be made up of crystal and will combine many technologies that will enable the user to run various applications and software anywhere and everywhere. Bringing up the concept of from being user friendly, we had used the crystal as the main material of the device that will trap the surrounding lights to produce projection of its screen. This leads to a lesser energy consumption and allows smaller sized battery to be used, making the device less bulky. Additionally, we proposed the usage of micro batteries as our energy source. Thus, researches regarding crystal were made along with explanations in details of specification and function of the technology used in the device. Finally, we had also drawn several views of the invention from different sides to be visualized.

***Keywords*—**Crystal, Communication Technology, Future concept device, Micro batteries.

I. Introduction

THE main concept in this paper is to transform an accessory into a device of communication technology. Bringing up the concept on inventing a communication technology device from the span of accessory, we intend to invent a necklace that can be worn by anyone. Usually, accessories are used to complete an outfit and are chosen to specifically complement the wearer's look. However, in this case, an accessory will not only complement one's outfit but will also act as a device that helps in assisting one's daily life routine for communication. A device had been proposed that can identify and provide information of a patient but also portrays as an accessories in a form of a wristband [1]. Thus, we had chosen necklace to be the communication device as it is convenient to be worn by everyone, anywhere.

In order for us to create a device that is able to function as a smartphone or a laptop in a small-wearable size, we have to figure out, how to reduce the energy consumption of the device and avoid a large battery that might take up big space. Currently, there are many devices that have been invented in order to fit the criteria of user friendly device. For example, the automatic control lab was designed with a user friendly interface for the student to learn in a more flexible distance learning [2]. Consequently, realizing the current need of the society for more user friendly products it has been an ongoing pursuit for us to invent a device that will consume lesser energy thus will allow smaller sized device to be produced.

An analysis had shown that higher energy consumption for a normal daily usage of a smart phone is used for the screen display besides CPU and network [3]. That is where the idea of projecting the screen in front of the user, with the help of the light from surrounding came to us. We have introduce the usage of gemstone in trapping the surrounding light as it will reflect the light to help in projecting the screen [4]. Therefore, more than half of the usual energy usage from the battery can be reduced. Furthermore, we are proposing to use high-power lithium ion micro batteries for the energy source in our device. This under developed technology will give a big impact to our device as it may give the device a long lifetime with only a short time of charging [5]. Therefore with the smaller size of the battery for the device, our device would be categorized as a user friendly device as it will come in a small size.

II. New Idea on Invention

We proposed an invention of a necklace named Nepros in the scope of communication technology that helps human to be connected with people from different countries from all over the world. We pondered upon an invention that combines many current technologies to assist communication from a broader and wider aspect. The Nepros functions as a device that enables users to run many applications and hardware such as camera, Internet and projector. In Nepros, the crystal helps in trapping and using the surrounding light to project the light as its first source of light and making LED as its second source for back up. This may reduce the energy consumption of the device as it uses the natural source of energy. Furthermore, Nepros uses micro batteries as their energy source, making the size of the device smaller thus qualifying it to be a user friendly device. An LTE modem is integrated in Nepros' processor to allow the user to connect with the wireless local area. There is also a built-in camera to make videos and to capture pictures besides facilitating the camera with sensors that can detect hand gestures to interact with the projected screen. It is made, as a necklace so that it is easy to bring with as well as to cater the market needs. The Nepros are suitable to be used by anyone regardless of their age and gender.

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III. Proposed Structure of Device

A. Basic Structure

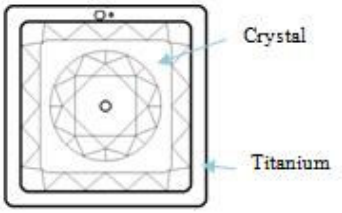

Fig. 1 Top view of the device

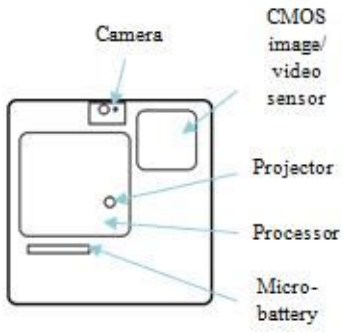

Fig. 2 Inner view of the device

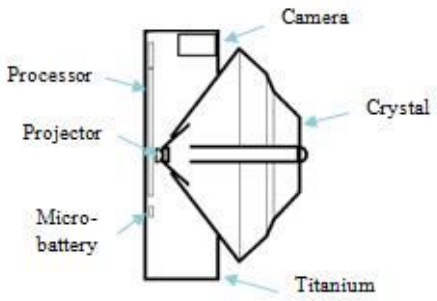

Fig. 3 Side view of the device

Fig. 1 shows the front view of the device that composed of Quartz Crystal at the middle and Titanium metal as the base. Fig. 2 shows the inner view of the device to show the components that had been integrated in this device which is the projector, micro-battery, Tegra 4i processor with integrated LTE modem, and a small Ultra CMOS Color Video Camera with the CMOS image/video sensor. While in Figure 3, we are showing the side view of the device that we would like to propose.

B. Crystal

The basic component of the device is the crystal that mainly acts as a medium of trapping the surrounding light and focuses it at the central base of the crystal to be projected out of the device. Crystal is a solid substance in which the atoms, molecules or ions are arranged in an orderly repeating pattern extending in all three spatial dimensions [6]. Thus crystal that is able to reflect the surrounding light will be the perfect material to be used. We are proposing the use of quartz crystal, which is the second most abundant mineral on earth, thus easily obtainable and cheap. Quartz has 1.543 as it refractive index [7]. The refractive index of the quartz will enable the light that travels through it to be reflected at the center of the quartz providing the quartz were cut in a proper way. Therefore, we proposed the modern brilliant cut for the quartz that should be like the diamond cut. More investigation regarding the quartz crystal will be explained in the proposed investigation part.

C. Titanium Metal

As the base of this device, we would like to propose the usage of titanium metal. The main reason for us to choose this material is because of its density being relatively lower than steel, making it lighter. Furthermore, titanium has the highest strength-to-weight ratio compared with other metals, thus its strength is greater. Titanium is chosen because it is skin allergies-free nature due to it being corrosive resistance and its inertness, thus everyone will be able to use it [8].

D. Projector

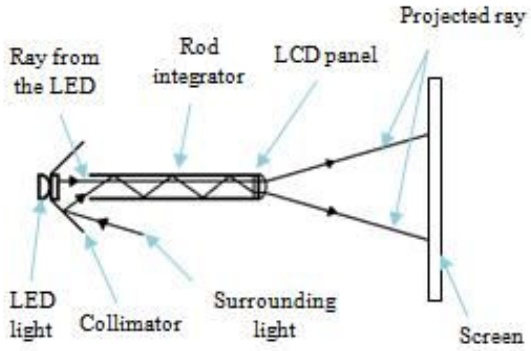

Fig. 4 Structure of the Projector

In projecting the screen, we would like to use an ultra small projecting system in this device, as shown in Fig. 4. The light source will come from two sources, which are surrounding light that had been refract through the crystal, as well as from the LED light that acts as the second source of light. This will help in reducing the energy consumption and at the same time, making the quality of the projected screen more brilliant.

The focused light from the surrounding will be reflected by the collimator to the rod integrator that was positioned in front of it and at the center of the quartz. As its slanting position helps in focusing the light and reflecting the light directly into the rod integrator, the collimator also helps in facilitate the process because it is made by shiny metal, allowing higher concentrated light to be reflected. The collimator will make the light collimate more effectively before being transmitted out, while the rod integrator will help in making a uniform transmission of light. Then the LCD panel will receive the light that had gone through the rod integrator and modulated it into images before it is projected to the screen [9].

E. Micro Battery

We propose to use the high-power lithium ion micro battery that had been developed by the researchers from the University of Illinois at Urbana-Champaign as the power supply for this device. This super-dense battery that may come in a few millimeters in size would be able to store and release a large amount of power, which is equivalent or higher than the best super capacitors [5]. The lithium-ion micro battery is built with a fast-charging cathode that had been integrated with a matching anode in inter digitated 3D bi-continuous Nano porous electrodes. It uses a design that provides a larger surface area for the cathode and anode. This technology is expected to be in the market once the researchers had found the way to create the batteries inexpensively.

F. Processor with LTE Modem

In this device, we will install the Tegra 4i quad-core System-on-chip (SoC) with integrated LTE modem. This model is the most recent released by Nvidia and focuses on combining a software programmable modem by Icera i500 LTE/HSPA+ baseband processor with the 4 plus 1 Cortex A9 cores architecture with the patented 5th battery saver core that helps in reducing power consumption of this device. It works with up to 2.3 GHz quad-core ARM Cortex-A9 R4 CPU architecture as the basis of the chipset and features 60 Core GPU arrangements. In this SoC, there are multiple components, including two CPUs design by ARM, a GPU that processes graphical and visual data, and also a number of sub-processors: video encoders and decoders, camera operation, and audio playback. This SoC incorporated a phone's modem (Wi-Fi, GPS, 3G/4G, etc.) where they developed the micro built-in radio transmitter and receiver. With the present of this LTE modem, the user can access the Internet for daily purposes, using GPS and more [10]. This device may actually serve as a replacement for a functional laptop or desktop.

G.Small Ultra CMOS Colour Video Camera

Together with this device, we are going to install it with a built-in camera that uses the small ultra CMOS Colour Video camera with built-in video transmitter. The camera set is very small. The camera is also used as a sensor, to capture images and for video recording. It had been exploited as a novel collaborative sensing platform. The near-real-time camera-based sensing is introduced for a windshield-mounted smartphone to capture the environment and give the information or knowledge about the environment for the smartphone users [11]. In the automobile industry, for example, a camera build-in rearview mirror is used to monitor the front, side or rear view of a vehicle to increase quality of the field of view for the driver [12]. Thus in our invention, we would like the users to capture their moments, record videos, and detect hand gestures with this small camera.

H.Skeleton-Based Hand Gesture Recognition

In this device, we are also going to install some software that can help the user to use our device in a more attractive way. One of the software that we would like to highlight here is the hand gesture recognition software that will allow the user to interact with the screen projected from the necklace without the use of any other mechanical input devices. This technology provides an attractive way for human-computer interaction (HCI). To make this technology functional, the camera and the processor must be installed with the hand gesture recognition software. The software has the mathematical algorithm to interpret the hand gestures of the user. There are few algorithms that are being used for the hand gesture recognition and among the popular are the 3D model-based algorithms, skeletal-based algorithms and appearance-based algorithm. Researchers stated that there are few disadvantages of the gesture interpretation by using *3D models* and the *appearance model* [13]. For 3D modeling it may lead to computational hurdles, appearance model on the other hand have a lack of generality desirable for the HCL. Thus we are interested in using the skeletal-based algorithms to do the interpretation of the gestures. A skeletal-based algorithm is a simplified version of joint angle parameters of the skeleton and it is used together with segment length. A 2D skeleton was also proposed to represent the hand forming a dynamic signature of hand gestures. They used one of the researchers' distances to measure dissimilarities between the model parameters of the signature with the one from the gesture alphabet [14]. While other researchers had used 3D hand model to represent the hand with 21 different parts. A random decision forest (RDF) is used to estimate the join location of the hand skeleton [15]. In Nepros, we would like to install the hand gesture recognition software that uses 3D skeleton-based algorithm, as it will be much faster because it only detects the key parameter of the hand. Basically, the virtual skeleton of the user's hand is computed and its position is mapped into assertive segments in 3D. It achieved the recognition purpose by analyzing the relationship between the various parts of the hand [16]. The camera sends the information to be processed and the software will detect any movement of the user's hand to interact with the projected screen.

IV. Proposed Research on Crystal

A. Quartz Crystal Background

Quartz is a chemical compound that consists of one part of silicon and two parts of oxygen. Quartz is among the crystals that has high refractive index of 1.543 and are among the most abundant mineral that can be found on earth. It is widely distributed in all parts of the world thus making it highly resistant to both mechanical and chemical weathering. In addition, high qualities of quartz crystal are the single crystal silica with optical or electronic properties which make them to be useful for special purposes such as filters, frequency controls, timers and much more. On the other hand, quartz is also being used for devices in technological advancement in computers and peripherals, telecommunications, industrial electronics and much more [17]. Along with this new advancement, comes the need of exploiting benefits of the quartz from the aspect of its properties and benefits.

Manipulating its reflection ability will give us the advantage of trapping surrounding lights for the device usage.

B. Reflection of Quartz Crystal

Reflection of the quartz is the area that will be properly investigated in order to understand and relate the usage of the quartz crystal for our device. The critical angle of the quartz is 35°. However, if the angle of incidence is more than its critical angle, total internal reflection will occur and it will reflect the ray that hit the surface of the pavilion facets, enabling the light to be focused at the base end of the quartz. With the help of the collimators at the base that act as a mirror, the rays will then be reflected out from the device to produce its screen projection. Thus, the cutting of the quartz will affect the result whether the gemstone will be able to form high or low amount of total internal reflection which will determine the brightness of the projected screen.

To get that ideal cut of quartz, proportion of distribution of parameters as well as the setting of angle and number of the facets must be taken into consideration. It is necessary to determine the way the quartz is being cut so that it will give the right angle for the light to be reflected at the right position. Hence, we propose the cut of the quartz crystal to be the same as a common diamond cut, which is the modern brilliant cut. The modern brilliant cut is proposed by Marcel Tolkowsky who described the ideal proportions of a round cut diamond [18]. This cutting will have 58 facets all together, that will be best suited to maximize the brilliance of light in the quartz. This is because, the greater the amount of facet that have the ability to reflect the light directly to the base of the quartz, the higher the quality of the projected screen as there are more light that can be focused. This feature can be found in the quartz with the modern brilliant cut as it may provide a substantial amount of pavilion facets in it. Furthermore, the quartz should not be cut too deep or too shallow. This will cause the light to be reflected at the wrong angles causing lesser potential light ray to be focused. In conclusion, if we would be able to cut the quartz in the best manner possible to exploit all the surrounding light that enters the gemstone, more light intensities can be focused by the quartz on its base to produce brighter screen projection.

C. Proposed Rays Pathway

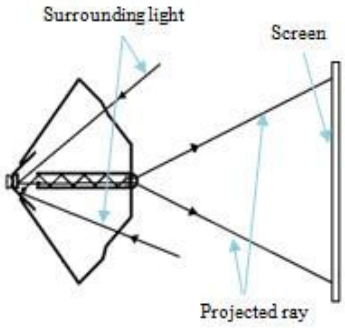

Fig. 5 Crystal Pathway

Based on Fig. 5, we propose on the usage of the quartz crystal because the high refractive index of the quartz crystal may helps in reflecting the surrounding light to the inner basal fragment of the quartz. However, in order to focus the light to the base of the quartz, we use collimators at the center of the quartz with a rod integrator in front of it so that the light travels in the right manner through it. The LED light will be used as the second source for the projection, giving the option for the device to be operated using two different source of light. Thus, when in the absence of light from the surrounding, the projector can still be used.

Previous investigation of the quartz has clearly shows that the manner the quartz are being cut is very important because it determines the angle of reflection of the light and the critical angle for it. Thus, the way the light is being reflected with the cut for the quartz crystal, are visualized in the above figure.

V. Survey Result

Before proceeding with this invention, we had actually made a random survey on fifty five volunteers with regards to the need of the current society. Table I shows the result of the questionnaires. It shows that the society demands for an integration of technologies into a compact device and in the same time the device is suited for the usage of people from different backgrounds. This survey had driven us to come up with an invention of a device like Nepros, a compact device that is user friendly. Later on, a simple survey was conducted to ask the feedback of our invention to random volunteers from different backgrounds. Fifty five volunteers were asked to complete and fill up on questionnaire about, will the Nepros help in assisting their routine daily life, will the production of Nepros get the society's attention, and will the production of Nepros help in increasing the number of devices that are user friendly and much more. All of the volunteers were informed about the Nepros before they were asked to fill up the questionnaires. Results of the questionnaires were shown in the table below:

TABLE I
Result of the Questionnaires

Questions	Result
1) Do you think that Nepros can help your daily life routine?	85% of the volunteers answered Yes and 15% of the volunteers answered No.
2) Do you think that Nepros can get the society's attention?	65% of the volunteers answered Yes and 35% of the volunteers answered No.
3) Do you think that Nepros will increase the number of available user friendly device?	80% of the volunteers answered Yes and 20% of the volunteers answered No.
4) Can Nepros creates awareness towards health maintenance?	70% of the volunteers answered Yes and 30% of the volunteers answered No.
5) If Nepros is an expensive device, will you afford to have it?	58% of the volunteers answered Yes and 42% of the volunteers answered No.

VI. Conclusion

The idea of inventing a compact device that is user friendly is the unique selling point for the Nepros. The supporting evidence for the statement is when relatively more than 60% of the volunteers answered positively in the questionnaires regarding the future outlook for the invention in the society.

It is concluded that the invention will be beneficial in major energy saving, easy and practical to handle with and does not focus on any specific group target as it can be used by any gender anywhere. Therefore, with more comprehensive research, we have the intention of making it into reality in the future.

References

[1] Petrick, K. D. U.S. Patent Application 09/907, 737, 2001.Topoulos, G. (2010). U.S. Patent Application 12/730,346.
[2] Casini, M., Prattichizzo, D., & Vicino, A. (2003). The automatic control telelab: a user-friendly interface for distance learning. *Education, IEEE Transactions on*, *46*(2), 252-257.
[3] Mittal, R., Kansal, A., & Chandra, R., "Empowering developers to estimate app energy consumption," In *Proceedings of the 18th annual international conference on Mobile computing and networking,* 2012, pp. 317-328.
[4] McCrary, Charles F. "Jewelry lighting device." U.S. Patent No. 5,323,300. 21 Jun. 1994.
[5] Pikul, J. H., Zhang, H. G., Cho, J., Braun, P. V., & King, W. P. . High-power lithium ion microbatteries from interdigitated three-dimensional bicontinuous nanoporous electrodes. Nature communications, 4, 1732, 2013.
[6] Howard, J. Michael; Darcy Howard (Illustrator) (1998). "Introduction to Crystallography and Mineral Crystal Systems". Bob's Rock Shop. Retrieved 2008-04-20.
[7] Jellison, G. E., and H. H. Burke. "The temperature dependence of the refractive index of silicon at elevated temperatures at several laser wavelengths." Journal of applied physics 60.2 (1986): 841-843.
[8] Donachie, Matthew J., "TITANIUM: A Technical Guide," in Metals Park, OH: ASM International, 1988, pp. 11.
[9] Kanayama, H., Maeda, M., Miwa, T., Ikeda, T., Murata, H., & Chihara, K., "Ultra small projector with high efficiency illumination system," In Consumer Electronics ICCE'06, 2006 Digest of Technical Papers. International Conference, 2006, pp. 127-128.
[10] Ansari, N., Lee, S., & Wu, Z. "Pre-Silicon Verification of Tegra Image Signal Processor".
[11] Misaiji, T., & Oooka, N. (2002). *U.S. Patent Application 10/293,301*.
[12] Koukoumidis, E., Martonosi, M., & Peh, L. S. "Leveraging smartphone cameras for collaborative road advisories," in Mobile Computing, IEEE Transactions on, 11(5), 2012, pp. 707-723.
[13] Pavlovic, V. I., Sharma, R., & Huang, T. S., "Visual interpretation of hand gestures for human-computer interaction: A review," in Pattern Analysis and Machine Intelligence, IEEE Transactions on, 19(7), 1997, 677-695.
[14] Ionescu, B., Coquin, D., Lambert, P., & Buzuloiu, V. "Dynamic hand gesture recognition using the skeleton of the hand," in EURASIP Journal on Applied Signal Processing, 2005, pp. 2101-2109.
[15] Keskin, C., Kıraç, F., Kara, Y. E., & Akarun, L, "Real time hand pose estimation using depth sensors," in Consumer Depth Cameras for Computer Vision, Springer London, 2013, pp. 119-137.
[16] Menier, C., Boyer, E., & Raffin, B. "3d skeleton-based body pose recovery," in 3rd International Symposium on 3D Data Processing, Visualization and Transmission (DPVT'06), 2006, pp. 389-396.
[17] O'sullivan, C. K., & Guilbault, G. G. (1999). Commercial quartz crystal microbalances–theory and applications. *Biosensors and Bioelectronics*, *14*(8), 663-670.
[18] Tennant, Smithson. "On the Nature of the Diamond. By Smithson Tennant, Esq. FRS." Philosophical Transactions of the Royal Society of London 87 (1797): 123-127.

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