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Medical Identifier Technology for Pilgrims during the Hajj Season

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ABSTRACT

Hajj is known as one of the Muslim's ritual duties as described in the Five Pillar of Islam. Since many people gather in one place, it tends to create many problems, especially in crowded environment, such as flood, fire and stampedes. It is not included with died pilgrims that always happen every year, because of age factor and unfortunate incident, as well as lost pilgrims that always been reported each hour during Hajj. Without papers that showing their exact location as well as contact number, yet with the problems of communication (language barriers), always puts a tremendous pressure on the security officers who taking care of pilgrims. This paper seeks to provide a comprehensive review about the potential technology and design which suitable to be implemented as a medical identifier. This medical device will be built into a new design of bracelet, due to be worn by pilgrims. This proposed bracelet is specifically designated for them, due to replace the existing bracelet worn by pilgrims as identification tag. It is equipped with additional function of technology, which capable to monitor the pilgrim's health condition, as well as pilgrims' data information.

Keywords: *Hajj, Five Pillar of Islam, Muslim's ritual, pilgrims, medical identifier, bracelet*

1. Introduction

Hajj is known as one of the Muslim's ritual duties as described in the Five Pillar of Islam, which represent one of the peak experiences in the life of a Muslim. The **Hajj** is the annual pilgrimage to Mecca, Saudi Arabia. The Hajj is a demonstration of the solidarity of the Muslim people, and their submission to Allah Taala. The pilgrimage occurs from the 8th to 12th day of Dzhul-Hijjah, the 12th and last month of the Islamic calendar. *Ihram* is the name given to the special state in which Muslims live while on the pilgrimage.

Each year more than two million Muslims from countries throughout the world arrive in Mecca, Saudi Arabia to perform Hajj. In year 2010, about three million pilgrims participate in this annual pilgrimage (World News by UPI.com, 2010) [1]. These pilgrims speak diverse languages. They are often older adults who have a variety of underlying health conditions. Since many people gather in one place, it tends to create many problems, especially in crowded environment. In previous Hajj seasons, there a lot of incidents occurred, such as flood, fire and stampedes, as well as clashes between the security forces and Iranian pilgrims during protesting against Israel and US in 1987 [5]. It is not included with died pilgrims that normally be happen every year, because of age factor and unfortunate incident. Besides, there also issues of lost pilgrims, that always been reported each hour during Hajj. Without papers that showing their exact location as well as contact number, yet with the problems of communication (languages barriers), always puts a tremendous pressure on the security officers who taking care of pilgrims.

Crowd-control techniques have become critical, and because of the large numbers of people, many of the rituals have become more stylized. But even with the crowd control techniques, there are still many incidents occurred during the Hajj - pilgrims are trampled in a crush, or ramps collapse under the weight of the many visitors, causing hundreds of deaths. The congestion and mass movement may place additional stress on these adults during the pilgrimage. Emergency medical intervention becomes complicated when medical history is difficult to extract due to medical conditions or language barriers. Moreover, in the case of death, it is difficult for the Ministry of Health to return an unidentified body to the country of origin.

Focus on this paper, we review the potential technologies to be implemented for Hajj purposes and any related works done on previous research for Hajj will be discussed in details. The technologies stressed in this study, will focus on the function of technology that capable to monitor the pilgrims health condition, as well as pilgrims data information. It is believed that, this proposed device invented was capable to assist the pilgrims and Hajj staff in managing and controlling pilgrims during Hajj season. This device will be installed in particular bracelet, which needs to be worn by pilgrims. This new bracelet will be replaced the existing bracelet, which normally used by pilgrims nowadays. Furthermore, the existing bracelets worn by pilgrims are only capable to show the tag of pilgrims' information, such as name, country of origin, identification number and others. Other details are completely listed in Medical Record of Pilgrims Booklet, which they need to bring it along at all time in their sling bag.

In this proposed bracelet, it will equip with additional function of medical identifier device, which has been installed inside the bracelet. It is supported by a certain hardware and software devices, which can detect the health condition of the pilgrims during the Hajj season. Most importantly, the rationale behind this invention is to help the Hajj management authority in handling and organizing their pilgrims effectively, especially in medical purposes. It is because, all medical records of each pilgrim's were stored inside this bracelet and it will be used by the management or medical staff as the main references, due to distribute the right medicine to injured and sick pilgrims.

2. Hajj: Application and Case Study

The authorities pose a great challenge of all sorts of problems covered about pilgrims and also responsible in facilitating the Hajj. The points as listed below are some of the common problems faced by the pilgrims and authorities alike due to the issue listed below [3]:

(a) Identification of Pilgrims (dead or injured)
(b) Medical Emergencies
(c) Guiding lost pilgrims to their camps
(d) Loss of identity documents
(e) Cramp environment

Due to above issues mentioned, the most practical and best solutions need to be considered, focus on system management related to pilgrims of Hajj, data tracking information especially health condition.

2.1 Existing Tagging for the Pilgrims of Hajj

A review on the existed tagging from Tabung Hajj and it is currently utilized by the pilgrims during Hajj.

Figure 1: Iron material of tag worn by the Indonesian pilgrims of Hajj [6]

This bracelet is given by the committee, in which bracelet bearing the identity of each pilgrim, such as Name, Group Fly (kloter), year of departure, a flag with the emblem of Garuda Indonesia (for Indonesian pilgrims), the committee telephone number in Saudi Arabia who could be contacted, and Passport number. This bracelet as an identity that must be taken along and used, made of iron, painted and written the assembly identity printed on the bracelet. The tag cannot be torn or taken out since it is an identification of the pilgrims as performing a Hajj and also as for emergency cases. However, in Malaysia the tagging is different from the above. Malaysian's tagging is detachable. It can be taken out and put it back on. This creates problems because; the bracelet can be lost and create a bigger problem in order to be identified as the Hajj pilgrims. Some materials where made from stainless steel – a better quality - and as for the low class material are made from copper or iron.

2.2 Surveys and Questionnaire

Survey is one of the methods conducted for this research. This survey questionnaire has been distributed to the targeted user which is in the age of 50-60's. Location of the survey is at Sogo Shopping Mall, Kuala Lumpur. Other than that, is at Salahuddin Musolla and Tun Abdul Aziz Mosque both in Seksyen 14, Petaling Jaya. The survey question is targeted to gain information on the new proposed product design requirements focus on technology. Before proposing the new product, it is best to know the difficulties of the existed product. Thus, in the surveys, questions regarding the existing are also to be included and the responds of the respondents is taken into consideration, which focus on certain aspects, such as:

(a) Time Frame – focus only the Hajj season
(b) User Category – The age level between 50-60's.
(c) Usage Category - The device acts as the medical identifier to the user (pilgrims) and the staff which can store personal information, yet also as a tracker which indicate the specific locations of each pilgrim.
(d) Technology consideration – the technology used in this device is mainly available in the market. For example, GSM (Global System for Mobile Communication), Pulse Rate Sensor (Pulse Rate Oximeter) and GPS Tracker.

3. Technology

Technology are needed to improve since the first attempt is already come up, so further research for more advanced machinery to be put on. The market demands will be more challenging since people are more aware with the latest gadget installed.

3.1 Existing Approaches/Technology

3.1.1 RFID (Radio Frequency Identification) Technology

In this approach, an RFID-based Pilgrim Identification System has been introduced and RFID has been used as the basis of research. Group of research lead by Mohammed, M. et al. (2007) [2] have go through the implementation of RFID towards pilgrims, which capable to be used as identification system. Due to uncontrolled situation of crowd pilgrims, age factor and sometimes unfortunate accidents, the death toll in Hajj season might happen. Many of pilgrims died on their own, without any identification document carrying by them. This situation brings a lot of problems to authority, to manage those dead bodies and to claim back by their own country. Thus, every year at the end of Hajj season, authority are confronted with 10 of dead bodies that are never identified or claimed. Furthermore, this problem is not easy to handle by Hajj authorities, since it is a moral obligation for them to identify and inform the families of these pilgrims who died, of the sad demise of their loves ones.

Because of that, they present a solution based on RFID technology to help the Hajj authorities in the identification of pilgrims, as well as in crowd control. Prototype of Pilgrims Identification System have developed, which employed a wristband RFID tag, an RFID reader and Graphical User Interface application, that running on a PC. A wristband of RFID tag worn by pilgrims' stores pilgrims' data, that can be used for identification, as a Hajj permit, to access medical history during an emergency and e-purse.

3.2 Proposed Technology

This proposed device is typically designed and developed using certain technologies, mainly to guide and assist the staff of Hajj in managing the pilgrims especially with health problems, which needed to follow up. Each pilgrim will be monitored from time to time in case of any emergencies. Meaning that, the product device when it is worn by the pilgrims and if anything happens to them, it will create and transmitted signal to the server, which alert the Hajj

staff for further actions. Below is the overview on the block diagram and circuit system of the proposed design, as shown below:

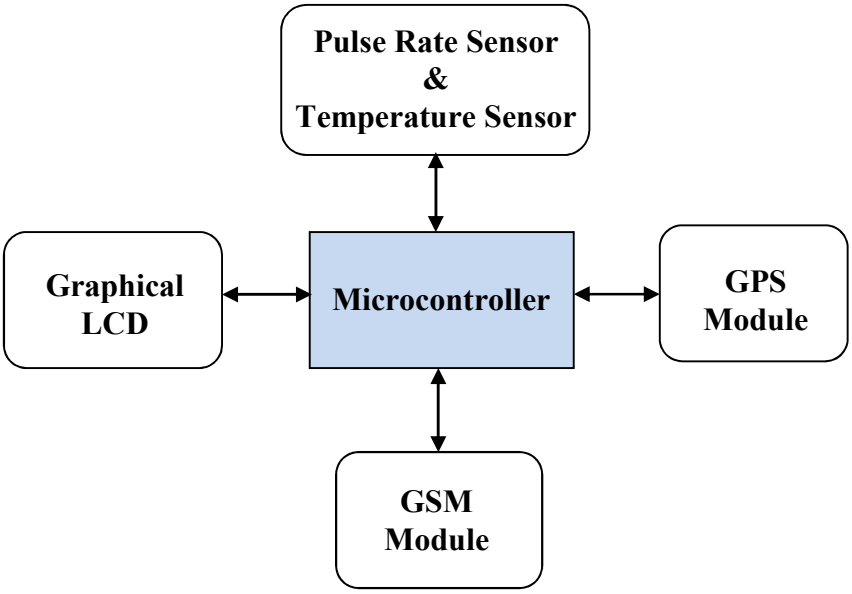

Figure 2: Block diagram of technology proposed

3.2.1 Features and Technology applied

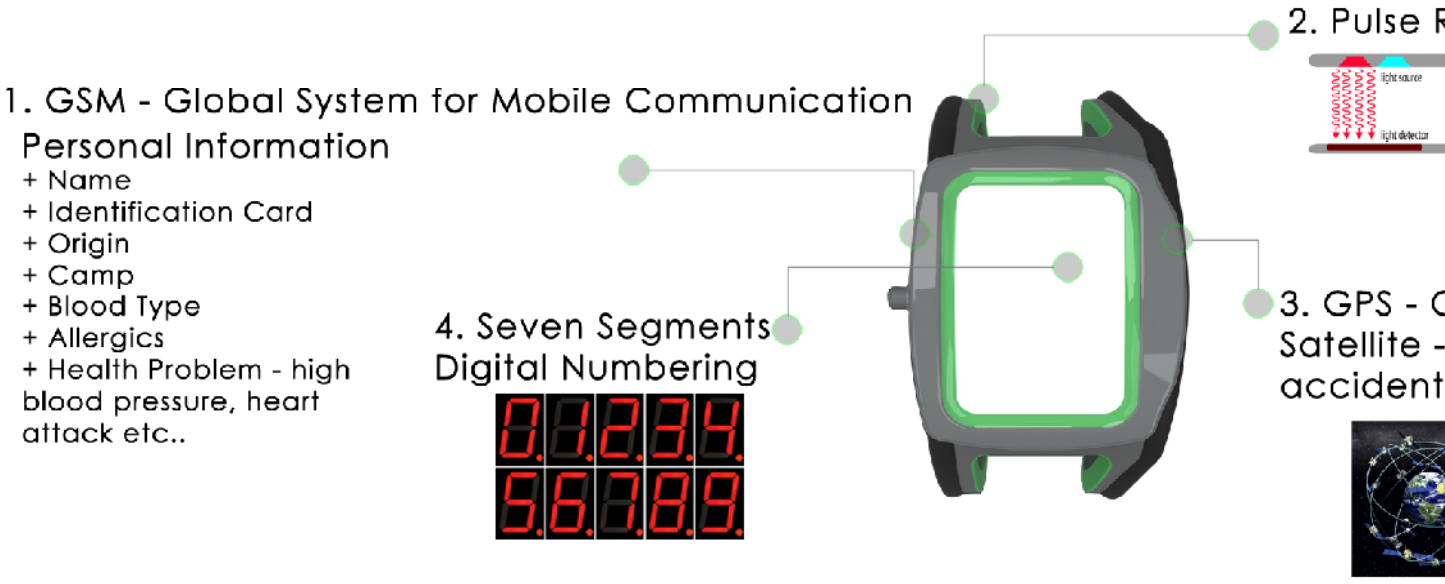

Figure 3: Featured technology

3.2.2.1 Technologies Implementation

(a) Microcontroller

A microcontroller is a compact standalone computer, optimized for control applications. Entire processor, memory and the I/O interfaces are located on a single piece of silicon so, it takes less time to read and write to external devices. Following are the reasons why microcontrollers are incorporated in control systems:

a) ***Cost:*** Microcontrollers with the supplementary circuit components are much cheaper than a computer with an analog and digital I/O
b) ***Size and Weight:*** Microcontrollers are compact and light compared to computers
c) ***Simple applications:*** If the application requires very few number of I/O and the code is relatively small, which do not require extended amount of memory and a simple LCD display is sufficient as a user interface, a microcontroller would be suitable for this application.
d) ***Reliability:*** Since the architecture is much simpler than a computer it is less likely to fail.
e) ***Speed:*** All the components on the microcontroller are located on a single piece of silicon. Hence, the applications run much faster than it does on a computer.

(b) Pulse Rate Sensor/Temperature Rate Sensor

Sensor is a device that measures a measurable attribute and converts it into a signal which can be read by an observer or by an instrument.

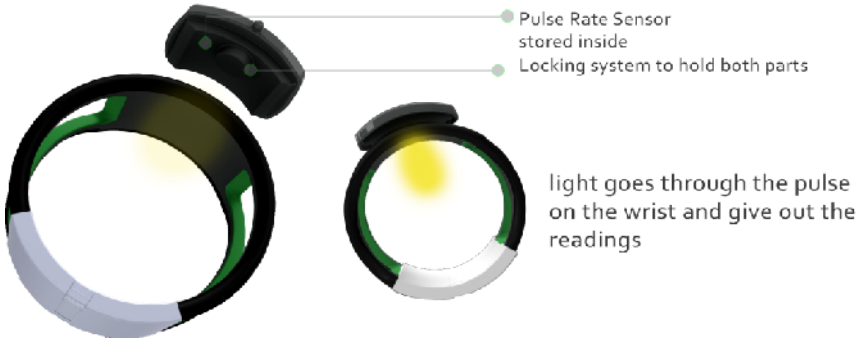

Figure 4: Proposed design of Pulse Rate Sensor

The concept used for the sensor implementation, are more towards the devices that will check the body temperature, blood pressure and the pulse rate. The result of device monitoring will be transferred wirelessly to a digital chart for later review purposes. If there is a significant change of patient's vital sign, the device will tell the medical care provider immediately. As a result, the health care can be given properly to the patients. This helps make the patients more comfortable and place less of a burden on the medical staff charged with their care. The concept of the device is similar with the concept design, which has been implemented by Dan Bishop [4], one of designer that conceives a medical device for helping medical staff in monitoring their patient remotely. The device was given the name of The Vital. The device is so useful for crowded hospitals; with lack of medical staff due to monitor their patient. Just wrist the device around patient arm, further the device will check body temperature, blood pressure and the pulse rate.

Figure 5: Vital - concept design of monitoring the health of patients (from Dan Bishop, 2004) [4]

(c) GPS (Global System for Mobile Communication)

GSM is the world's most popular standard for mobile telephony system. It is a cellular network, which means that the mobile phones connect to it by searching for cells in the immediate surrounding area. This ubiquity means that subscribers can use their phones throughout the worlds, enabled by international roaming arrangements between mobile network operators.

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM Card. The SIM is a detachable smart card containing the user's subscription information

and phone book. This allows the user to retain his or her information after switching handsets. Here, the number from SIM Card is considered as ID number for each pilgrim. Thus, under the same technology, GSM can be modified into compatible system which can be used and installed in this proposed device for pilgrims. The existing of pilgrims at every each corner of Mecca will possibly detect, without any trouble. The function of this GSM was mainly focus on transmitting the data information of the pilgrims (Health condition). Any information from pilgrims can be transmitted to Hajj Management authority (Hajj Base Main Camp/Center), through GSM network without any limitation and weaknesses compared with RFID, with limited coverage. This device is controlled by micro controller, where it acts as the location filter and sends the data to GSM and transfer the data to be seen on the data center or server (computer); which is a recognizable interface. Other than that, is the installation of Quranic verses in a MP3 format. This is to be connected with the microchip where if converts the analog data to digital in order it is readable and can interact with the user.

(d) GPS (Global Positioning System Satellite)

GPS is a space-based global navigation satellite system, which provide reliable location and time information in all whether, at anytime and anywhere on earth. It is very practical to be used for tracking the pilgrims by sending an exact coordinates and location of pilgrims. Through this technology, the problems related with lost and sick pilgrims can be managed and controlled effectively by the authority. Like a cell phone, a GPS receiver relies on radio waves. But instead of using towers on the ground, it communicates with satellites that orbits around the Earth. There are currently 27 GPS satellites in orbit – 24 are in active use and 3 act as a backup in case another satellite fails. In order to determine a location, the GPS receiver has to determine:

- The locations of at least three satellites above a person
- Where the person are in relation to those satellites

The receiver then uses **trilateration** to determine a person's exact location. Basically, it draws a sphere around each of three satellites it can locate. These three spheres intersect in two points – one is in space, and one is on the ground. The point on the ground at which the three spheres intersect is a person's location.

(e) Graphical LCD

The data information of pilgrims' health condition will be display from the bracelet, through electronic visual display. Overview of the data information display is same likely as a watch, shown in figure 6 below. The proposed technology for Medical Identifier, will give the data information of health from each pilgrims such as pulse rate value, temperature, blood pressure etc. Those data will transmit to main base camp, for monitoring purposed from Hajj authority.

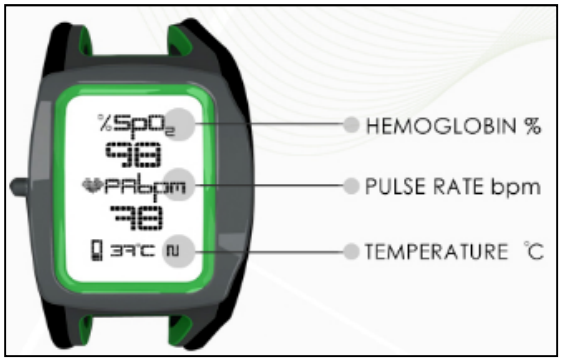

Figure 6: Screenshot of proposed LCD interface

4. Result & Discussion

4.1 Technology

In this paper, we prefer to use GSM instead of well-known RFID's. This is because GSM are more wide range of network which can cover up the whole Mecca. This GSM is mostly referring to the mobile telephony system, which totally depend on roaming provided by mobile network provider. It is a cellular network, which means that any mobile phones connect to it, able to be search in the immediate surrounding area. Thus, under the same technology, GSM can be modified into compatible system which can be used and installed in this proposed device for pilgrims. The existing of pilgrims at every each corner of Mecca will possibly detect, without

any trouble. The function of this GSM was mainly focus on transmitting the data information of the pilgrims (Health condition).

In other hand, the capability and function of RFID that is limited and only suitable to be used for small purposes. By tracking the code number in the RFID, the data stored was only the identification personal data. Besides, the range of wireless for the RFID is only covered in a small range of distance. The example of current application using the RFID is the "Touch n Go" card. If this kind of technology been applied and installed into the device for pilgrims of Hajj, the possibilities of Hajj staff in monitoring and tracking the pilgrims will going to be more difficult. Unless, there were a lot of RFID panel built at every each corner of Mecca and Madina. It is because, the frequency range covered by RFID only for a short distance, and it not practical enough to be implemented.

This device is controlled by micro controller, where it acts as the location filter and sends the data to GSM and transfer the data to be seen on the data center or server (computer); which is a recognizable interface. Other than that, is the installation of Quranic verses in a MP3 format. This is to be connected with the microchip where if converts the analog data to digital in order it is readable and can interact with the user. The circuit is attached together with a micro controller together and GPS Tracker and also Pulse Rate Sensor. For the display of data, the device must comprise of the seven segments digital numbering. The interface is also must be simple and easy to understand.

4.2 Result of Survey and Questionnaire

Most of the respondents' ages are within the range of 50-60's and, they at least had performed Hajj once in a life time.

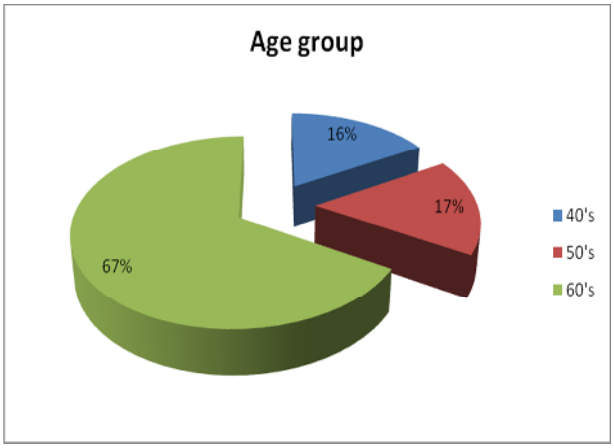

Figure 5: Pie chart indicating the age group of respondents

(a) Existed Design Bangle

For the first question regarding the bangle whether is gives comfort or not and most results tick as **No**. Second question where ask whether they have been taken the bangle and the majority result is **Yes**. Last is whether they have lost the bangle or misplace the bangle or not and the majority answer was **No**.

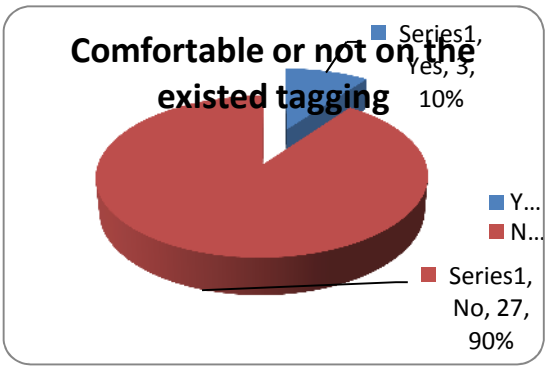

Figure 6 (a): Pie chart indicating on the respondents comfortable or not on the existed product

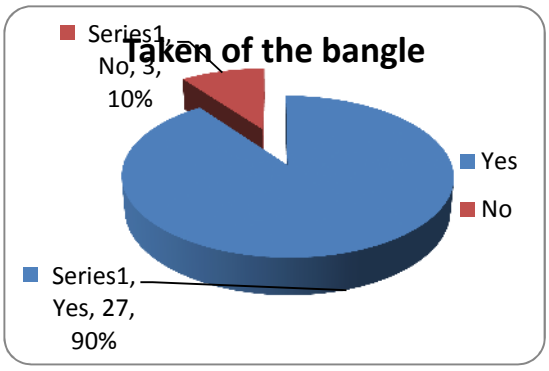

Figure 6 (b): Pie chart indicating on the whether the respondents took of the bangle or not

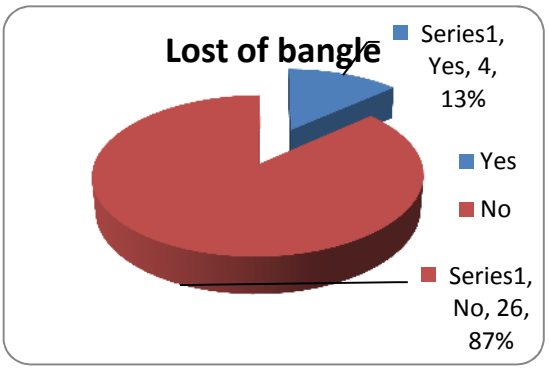

Figure 6 (c): Pie chart indicating whether the respondents lost the bangle or not

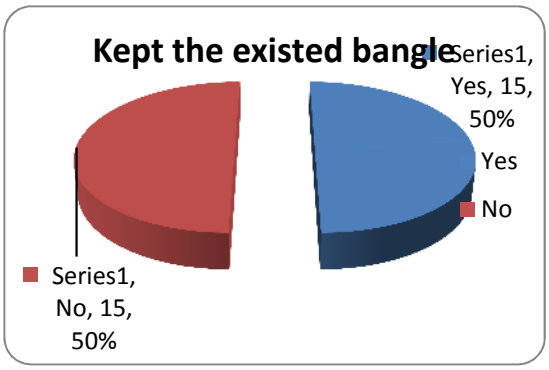

Figure 6 (d): Pie chart indicating whether the respondents still kept the bangle or not

(b) New Proposed Design/Development

Based on the survey, we can conclude that most of the respondents have performed Hajj. Most of them are facing problems with the existed tagging (bracelet). The causes of the problems are because of the material itself, and other problems are because of the possibilities of the bracelet (ID tag) to open – locking system. For not taking the risk of losing the bracelet (ID tag), most of pilgrims always kept it inside their sling bag.

Other questions are regarding the new design in terms of the shape, materials and level knowledge of technology. From the result, most of the target user prefers a wristband like device rather than the necklace or ring. Materials are preferred as plastic and their level of technology are intermediate. The proposal technology applied must be very simple and easily understood to nearly all stages of people.

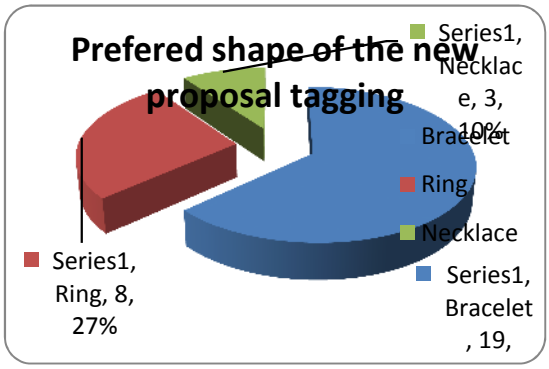

Figure 7 (a): Pie chart indicating on the best material selection for the new proposal tag

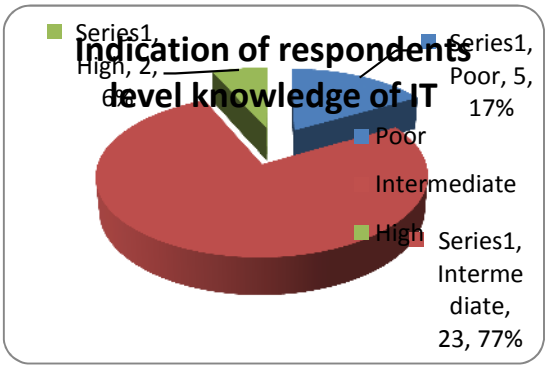

Figure 7 (b): Pie chart indicating the respondent's level knowledge of IT

According to figure 4 (a), the idea of the necklace comes up, because considering the disables without any hands. Proposing a necklace (device worn on the neck) and its status in Islam either allowed or not offended to any Islamic Syariah need to be confirmed, first. However, most respondents feel the bracelet is more convenient to be worn.

5. Conclusion

As what has been review on the above, nearly all considerations have taken into account to solve the problems occurred. The proposed design is to be proposed to the Tabung Haji of Malaysia for the consideration in making this in production. Since this is the first attempt, they

may be some constraint to the design and technology used. This is because, as years gone by, higher technologies are invented. The market demands will be more challenging since people are more aware with the latest gadget installed. The research executed and implemented to English language only. Thus, in the future the product can provide choices of languages so that it can be understood to all especially when in a critical condition.

6. References

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