

IoT Based an Efficient Image Processing Algorithm for Capture Image in Museum using Localization Service for User Involvement

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Abstract

The emergence of new technologies makes everything in today's world to be smarter. The innovation focused toward IoT leads to the enhancement of the domestic environment. The smart environment provides advanced services to the user by allowing the environment address to user and user address to the world. The Museum is a place where work of art, scientific specimens or other object kept permanent and displayed. This paper, to design a smart museum that brings comfort to visitors through wearable device, interacting with IoT based smart environment to act as a museum guide. The localization service is provided by the Beacon device which is installed in the museum. The user has the wearable device, which capture the image of user interested artwork and the image processing algorithm analysis the captured image. Once the image is recognized, then the result is forwarded to the proceeding center along with this localization information. The proceeding center retrieves this content from outside world of the cloud and sent them to the user mobile devices. This system improves the experience of user by delivering the content to the user three times faster than the system not using localization service.

Key-words: Internet of Things, Localization Service, Beacon Device and Smart Museum.

1. Introduction

The internet of things will interface object around us to give constant communication and contextual services provided by them. It also depicts a future where consistently physical object connected with the web and furthermore ready to recognize themselves to others devices. It provides

solutions based on the integration of information technology, which refers to software and hardware used to recover, store and process data and communications technology which includes electronic framework utilized for communication between individuals or groups. It make to recognize the object themselves and acquire intelligence by enabling context related choice to the fact that they can communicate information about themselves. The goal of internet of thing is enable object to associate with whenever, anyplace with anybody and anything utilizing the web and some other administrations.

By replacing physical effort, dangerous and redundant tasks with automated agents, the smart environment aims to improve the user experience in all environments. In this regard, an associated internet of things (IoT) might be provided a basic job, which incorporates the growth of the internet to almost nothing and minimal effort "things" that are assumed to recognise smart environment with a specific particular outcome to give new services to their users. IoT aspires to create a better world for people in which smart objects around us understand what we like and need and behave suitably without making unambiguous moves. To attain this aim, the present life is intent on accepting passive-power, passive-effort immerse innovation at regular things, resulting in true smart objects.

The walk on part of the handy phone and wearable devices is growing in tandem with the IoT concept. Blue tooth connected devices and panels, for example, are almost all embracing society after all not just communicated with these devices, but requires some of the control tools for the clients. Hence, the pattern to utilize the latest tool for environs is progressively across the board. The cloud is a key technology in the digital world which play a role to store and share the data or information between the services and the users.

With all the above consideration, it possible to design the smart environment for the museum to enhance the user experience. In detail description, the user mobile device is integrated with the wearable device and allow users to interact with the museum environment and provide an interactive cultural experiences. The beacon device is installed in the museum and it provide unique identity to the user devices and every artwork in the museum. The localization information is obtained by the beacon device which is used to identify the user location. The comprehensive details is stored and it used to speed up to send the details of the user observed artistry to the customer personal device. In addition the user allow to post the review and feedback about artwork that is being admired but the user are not allow to share the artwork content on their social networks because the sharing of museum content reduce the visitors to the museum This system can also monitor the status of the environment and change it based on a specific occurrence or a user's custom portfolio. The management used the information on the state of the environment to restructure the museum's

opening and closing times. The cloud is utilised to store all of the museum administrator's multimedia assets as well as user comments. When a user requests a certain piece of cultural content, the wearable gadget sends a video frame of the artwork to the processing centre, which then collects the data from the cloud and sends it to the user's mobile device via location services. The smart museum which as the benefits to both the museum visitors and the museum management. The information provided by the smart museum is easy to understand and the administrator may provide additional service to the museum visitors by observing the status of museum environment and feedback provided by the visitors. This system also connects the real world with the digital world inside the museum composed of myriad of information.

2. Related Work

Since the invention of smart museum, the various technologies used by the museum have evolved a lot,

Stefano Alleto et al (2016), presented the indoor location aware system for smart museum [16] uses a blue tooth connected with localization and image processing skills to normally give users with artwork content that they have observed. The museum's location information was provided via the Bluetooth Low Energy (BLE) device. Furthermore, the system makes use of the cloud to store the user's multimedia information and allows them to share environment-generated events with their networks. Finally, numerous location aware services operating on the system govern the environment state based on the user's movement.

K. Mainetti et al (2015) proposed a software ecosystem [14] that allowed various talented users to develop the location-aware services to autonomously control the Smart Home. These services manage the environment in accordance with the user's location and user-specified rules, which calculated by exploiting an indoor localization mechanism. In addition, to interact directly with smart devices, users can also define specific interfaces for mobile devices. Finally, a multi-protocol middleware allows both the location-aware services and the mobile applications to access the physical network which hiding the underlying heterogeneities. However this system takes more time to locate the user location at a particular point of time.

L.V. Moreno et al (2014) proposed an allocation based access control for the new smart plan application in the context of New Location-Aware Authorization Mechanism for Indoor Environments [13]. The paper concluded the authorization decisions by considering both access credential and location data. The estimation technique also were discussed using magnetic field data

the same details sent by the customers. Thus the system mechanism and benefits are discussed for the tensile solution for indoor environments.

Rubino. I et al (2013) described about the Museum Assistant (MusA) [15], it was a general framework for the development of multimedia interactive museum guides for mobile devices. The main feature of this system was a vision-based indoor location system that enables the provision of various location-based services, ranging from way finding to the personalized and contextualized communication of cultural content. The MusA framework allowed the rapid development of mobile guides for cultural institute and museums.

G. De Luca et al (2013) created and evaluated a software and hardware architecture capable of managing and monitoring a KNX-based safe house controlling system. Instead, many approaches to solving the issues of connected medley are built on the concept of general term. It is a critical configuration system capable of presenting application oriented communicates to the top layers while masking the heterogeneity of the underlying technologies.

Fortino, G et al (2012) described in [6] about the suitability of the technology and agent paradigm to effectively support the development of multi-layered agent based architecture and an IoT based infrastructure. The architecture as a wide variety of smart objects, from reactive to proactive, from small to very large, from stand alone to social.

J. Wang et al (2012) proposed location aware lifestyle [10] improvement system to save energy in smart home. This system lets users who live in the smart-home be aware of wasted electricity, their life style and then improves their lifestyle. The system detect the various information such as user location and energy-usage of home electrical appliances. And then, the system acknowledge situation of energy wastage and provide services to improve the user's lifestyle.

L. Caviglione et al (2011) presented a framework [11] to deploy RFID driven smart environment to provide personalized content and ad-hoc, to visitors in cultural settings. The architecture choices, from both the viewpoint of required hardware and related interaction paradigm. At last it also presents a preliminary performance evaluation to quantify the produced network traffic.

3. Proposed Methodology

The design of an indoor location aware architecture able to improve the user involvement in the museum through wearable devices, interacting with an IoT based smart environment in the museum to act as museum guides and provide real interactive cultural experiences to the users. The

system depends on wearable device that combines localization information and image recognition to automatically provide the information about the user requested artwork.

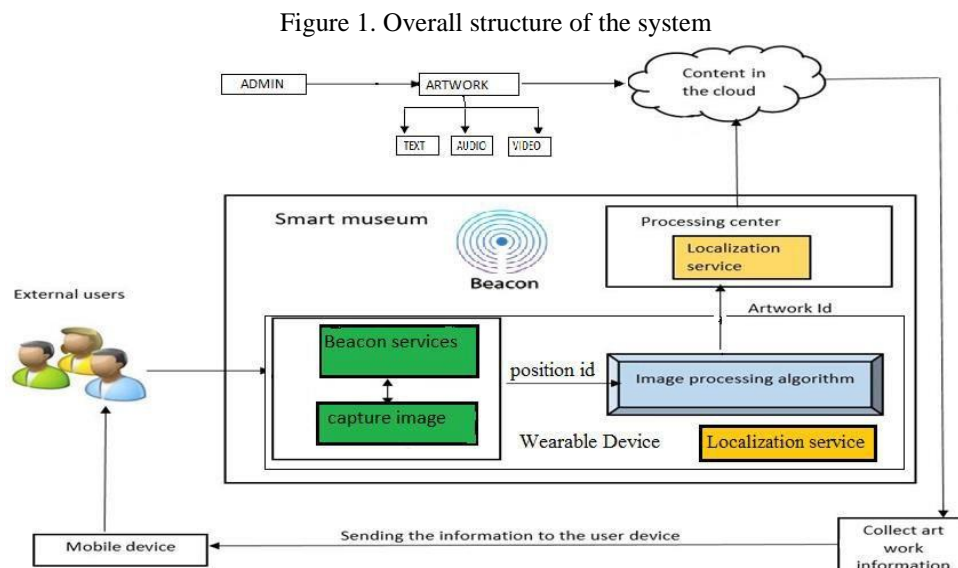
A. System Architecture

The overall structure of proposed system architecture is shown in figure 1. It is divided into four important components in the description is given below.

Artwork Content Storage- In this module, the administrator of the museum has login credentials of the cloud and they can update the artwork content for each rooms based on the Beacon type. And also they can update each artwork tutorial. The artwork tutorial may be uploaded as video, audio and the textual information and then content will be uploaded in a cloud.

Service used to locate user position - The localization service is run in both the wearable device and processing center. At first it detects the user location and sent the information to proceeding center. The customer details are saved and used for all purposes. In connected device, it analyze the application of image processing algorithm and in proceeding center it speed up the process of sending the cultural content to the user device.

Image Processing Algorithm- In this module, the wearable vision device captures the user-observed artwork as a video frame and analyses the captured frame in real time to realize the distinct object with high definition and performability. The proceeding center receives the identified result of the further activity.



The proceeding center is the heart of the major logic system. The user-requested cultural content is retrieved in the cloud, and the collected content is intelligently delivered to the user's personal devices. The processing center's localization service provides them with location data obtained from the beacon system. These services offer a cultural experience that is interactive.

The system is based on a connection that access the image capture and customer capabilities to transmit cultural details about the seen artistry to the customer device automatically. The user can participate in interactive cultural activities at the smart museum. The wearable device in this proposed system combines the results of the selected target object and the localization information obtained by the beacon in the smart gallery. Furthermore, the system stores multimedia content created by the user and museum administrator in the cloud. Finally, the system's location aware service keeps track of the museum environment's status based on user movement.

B. Location Aware Service

The several component in the system is depend on the location aware service. The service consists of three main element; 1). The beacon infrastructure which is installed on the museum periodically collect and sent the localization information of the museum visitor; 2). The service which run in the wearable device collect the landmark information to identify the location; 3). The service running on the processing center receive the location information about the user from the wearable device and provide it to the service. The beacon equipment was placed separately in each of the building's rooms. The wireless landmark with the beacon interface is one of the embedded devices. Each Beacon infrastructure sends its unique location identification (ID), and the service operating on the user's wearable device collects location data from all nearby landmarks to establish the room in which they are located.

C. Object Realization

To realize the art gallery of user requested, the preprocessing step is made on the video frame taken by the camera in wearable vision device. The camera is in movement during the image captured. As a result, there is a lot of blur in several parts of the video sequence, and the image is of poor quality. To remove blur in the frame the preprocessing step is taken and improve the quality. This process is done by analyzing the amount of gradient. Once the blur in the frame is removed, the image is recognized using the background subtraction technique. It extract the foreground of the

image for further processing. After the stage of image preprocessing, the localization is required which may make use of this technique.

The location aware service use in this system greatly reduce the using of other requirements this improves the precision of the matching process. The localization information provided by the Beacon system is used to do this analysis. The current frame is compared to the artwork template in the room where the user is now located. The image processing method helps keeps the wearable device's battery charged. The Beacon technology consumes low power and also it does not require any additional hardware.

D. Content Delivery and Interaction with IOT based Environment

When the image processing system recognizes the image, the unique id of the observed artwork is communicated to the processing center over the museum's WIFI network. The desired cultural content is accessed from the cloud and sent to the user using key information. Hence, a featured service is in performing of getting and assessing all customer responses in order to begin the right procedure. The reading of the artwork identification yields two possible outcomes. In the first scenario, delivering an audio description for the artwork that the user has observed. The multimedia cultural content is supplied to the interactive display in the second example, so that all other users have access to the same information at the same time. The services provided in the proceeding center are to follow with the environment based on the information given by the localization service. More in detail, the use of IoT technologies, made the environment to be modified in real time in order to provide the real interactive cultural experiences to the user.

E. Comparative Study with Existing System

The suggested method divides the execution time into two basic components: content delivery and image recognition. Other components, such as BLE communication, have a negligible impact given the scale of these two phases. If the system does not employ the localization service, the time it takes to recognize a user-requested object grows linearly in proportion to the number of artworks in the collection. In figure 2, the average of five artworks per room and a total of ten rooms, exploiting result of localization in an average processing time single frame of 1600ms. And then, recognition against the entire museum database average result of 6000ms.

Figure 2 - Average Time Consumption for Image Recognition and Content Delivery

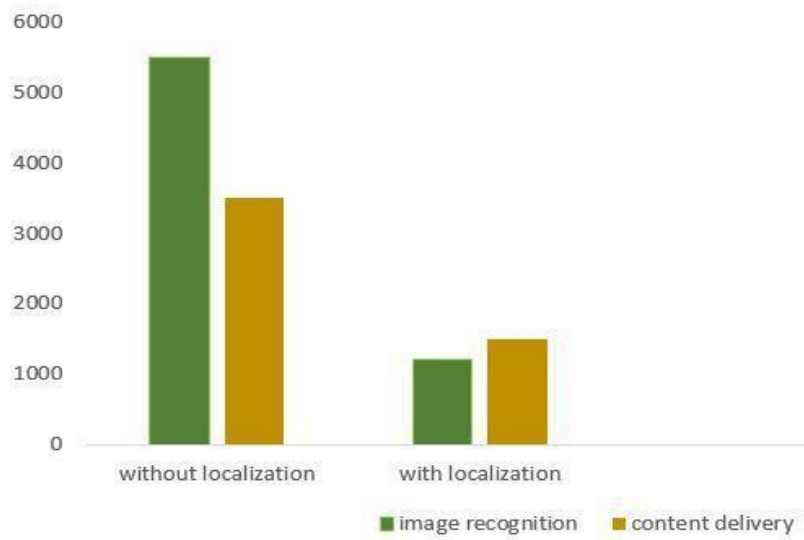
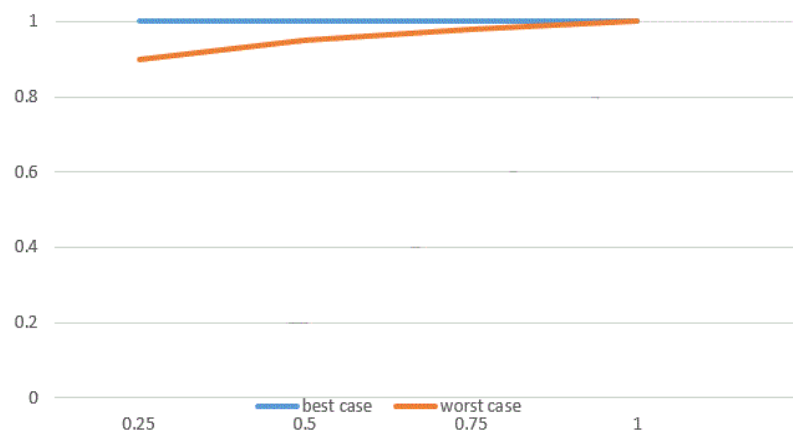


Figure 3 - The Probability of Detecting User Location with Worst and Best Case of Beacon Device



In this situation, have to implement an efficient work nature with faster than the existing of 3 times is crucial. Furthermore, the proposed architecture required a smaller battery and reduced the amount of computation required for each frame, resulting in longer battery life and more visits. The beacon devices that characterise the localization infrastructure have been positioned on the partition between two rooms in the primary scenario, referred to as the best scenario, such that they are not in visible pathway of each other. The devices were positioned in a viewable corridor at 5 metres from the dividing door in the second example, referred to as the worst scenario. We were able to determine the successful localization probability, which is the likelihood of correct localization of the object. Inside the room is a user. Figure 3 depicts how, in the best situation, the obtained outcomes are ideal, but in the worst situation, they are close to perfect.

4. Conclusion

This article described a smart museum that is based on a localization service and uses an IOT aware architecture. The beacon infrastructure, which is dispersed between the Wearable device and a processing centre, obtains the location information. With the integration of a location service and an image analysis system, museum visitors obtain cultural content connected to the observed artwork. The content is collected from the cloud and transmitted to the user's personal devices by the processing centre. Furthermore, based on user mobility, the localization information is employed to maintain the museum environment status.

References

- D.G. Lowe, "Object recognition from local scale-invariant features," in *Proc. 7th IEEE Int. Conf. Comput. Vis.*, 1999, vol. 2, pp. 1150–1157.
- Dr.S. Muthusundari and K. Varalakshmi- "Survey Paper - Digital Experiences in Iot Based Smart Museum Using Location Aware Service" in 2017 International Conference on Advanced Computing and Communication Systems (ICACCS -2017), Jan. 06 – 07, 2017, Coimbatore, India.
- E. Lau and W.Y. Chung, "Enhanced RSSI-based real-time user location tracking system for indoor and outdoor environments," in *Proc. Enhanced RSSI-Based Real-Time User Locat. Track. Syst. Indoor Outdoor Environ. Convergence Inf. Technol.*, Gyeongju, Korea, 2007, pp. 1213–1218.
- F. Sparacino, "The museum wearable: Real-time sensor-driven understanding of visitors' interests for personalized visually-augmented
- Facebook Inc. (2015). "Facebook Graph APIs," <https://developers.facebook.com/docs/graph-api/reference/>
- Fortino, G., Guerrieri, A., Russo, W. Agent-oriented smart objects development. In Proceedings of the 2012 IEEE 16th International Conference on Computer Supported Cooperative Work in Design (CSCWD), Wuhan, China, 23–25 May 2012; 907–912.
- G. De Luca, P. Lillo, L. Mainetti, V. Mighali, L. Patrono, and I. Sergi, "The use of NFC and android technologies to enable a KNX- based
- H. Bay, T. Tuytelaars, and L.V. Gool, "Surf: Speeded up robust features," in *Proc. Eur. Conf. Comput. Vis.*, 2006, 404–417.
- J. Matas, O. Chum, M. Urban, and T. Pajdla, "Robust wide-baseline stereo from maximally stable extremal regions," *Image Vis. Comput.*, vol. 22, no. 10, pp. 761–767, 2004.
- J. Wang, C. Zixue, L. Jing, O. Yota, and Y. Zhou, "A location-aware lifestyle improvement system to save energy in smart home," in *Proc. 4th Int. Conf. Awareness Sci. Technol.*, Seoul, Korea, 2012, pp. 109–114.
- L. Cavaglione, M. Coccoli, and A. Grosso, "A framework for the delivery of contents in RFID-driven smart environments," in *Proc. IEEE Int. Conf. RFID-Technol. Appl. (RFID-TA)*, 2011, pp. 45–49.

- L. Mainetti, V. Mighali, and L. Patrono, “A location-aware architecture for heterogeneous building automation systems,” in *Proc. 14th IFIP/IEEE Symp. Integr. Netw. Serv. Manage. (IM’15)*, Ottawa, ON, Canada, May 11–15, 2015, pp. 1065–1070.
- L. Mainetti, V. Mighali, and L. Patrono, —An IoT-based user-centric ecosystem for heterogeneous smart home environments, in *Proc. IEEE Int. Conf. Commun. (ICC’15)*, London, U.K., Jun. 8–12, 2015, pp. 704–709.
- M.V. Moreno, J. L. Hernandez, and A. F. Skarmeta, “A new locationaware authorization mechanism for indoor environments,” in *Proc. 28th Int. Conf. Adv. Inf. Netw. Appl.*, 2014, pp. 791–796.
- Rubino, I.; Xhembulla, J.; Martina, A.; Bottino, A.; Malnati, G. MusA: Using Indoor Positioning and Navigation to Enhance Cultural Experiences in a Museum. *Sensors* 2013, 13, 17445–17471
- Stefano Alleto, Rita Cucchiara, Giuseppe Del Fiore, Luca Mainetti, Vincenzo Mighali, Luigi Patrono and Giuseppe Serra: “An Indoor Location-Aware system for an IoT Based Smart Museum”. In *IEEE Internt of Things Journal*, vol. 3, no. 2, april 2016.
- T. Kuflik, O. Sagy, J. Lanir, A. Wecker, and O. Mogilevsky, —A differ- ent kind of experience: Using a smart mobile guide for education and aging research at the Hecht museum, in *Proc. Annu. Conf. Museums Web*, Portland, OR, USA, 2013.
- The American Alliance of Museums. Center for the Future of Museums. Available online: <http://www.aam-us.org/resources/center-for-the-future-of-museums> (accessed on 31 August 2014).
- Thinagaran perumal, Soumya Kanti Datta and Christian Bonnet, “IoT Device Management Framework for Smart Home Scenarios” in *IEEE 4th Global Conference on Oct.2015*.
- University of Haifa. (2015). Handheld ‘smart’ museum guide unveiled, *Science Daily*, Mar. 21, 2007. <http://www.sciencedaily.com/releases/2007/03/070319175959.htm>
- Youn Sun Cho, Lichun Bao and Michael T. Goodrich “LAAC: A Location-Aware Access Control Protocol” in *IEEE Transaction on Mobile and Ubiquitous Systems*.