Telecommunications Field Operations Supported by Augmented Reality – a Systematic Review

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***Abstract* - The main objective of this study has been to perform an extensive systematic review of publications related to augmented reality and how this technology can aid field operations for the telecommunications industry. The expected result is to validate the feasibility of a new proposed framework, which consists of an augmented reality application that makes use of mobile device sensors, such as GPS and compass, a database and computer vision, to provide relevant information to the user, who is in this case a technician working for a large telecommunications operator.**

Keywords - Augmented reality, field services, maintenance, computer vision, telecommunications, systematic review

I. INTRODUCTION

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II. MOTIVATION

A large telecommunications operator in Brazil performs over 10 thousand customer activations per month, using fiber optics, specifically GPON (Gigabit passive optical network) technology. A common network topology for this kind of networks is shown in Figure 1. Splitters are positioned in street poles and are sealed plastic boxes that connect the customers to the network. Each splitter can reach up to 16 customers, delivering ultra-broadband internet access, with download bitrates up to 300 Gbps (Gigabits per second).

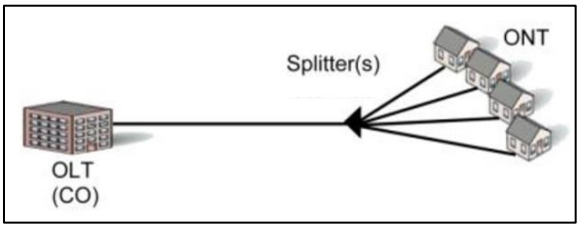

Figure 1: Illustration of a GPON Network Architecture. A OLT (Optical Line Terminal) is a central network equipment and a ONT (Optical Network Terminal) is a customer equipment. A splitter connects to several ONTs.

There is a huge demand for new applications to be used in mobile devices, by technicians. Their job consists in identifying the splitter that is nearer to a new customer who has requested the ultrabroadband service and connecting a fiber from the splitter to the customer. Since they have several tasks assigned to them throughout each day, it would be helpful to have an application to help installation and maintenance work, identifying the equipment that is next to the employee, as well as showing relevant information to aid his work. Any increase in productivity is welcome, since the telecom industry is facing the need to reduce costs as much as possible, so the telecommunications operator has expressed the need for a new mobile application.

III. RELATED WORK

In order to confirm that the proposed system will actually provide relevant contribution to the field, compared to existing approaches, a systematic review has been performed, with search strings such as “augmented reality”, “telecommunications”, “field services” and “operation”.

The searches considered only articles published between 2010 and 2018, and in English language. Four databases were included: IEEE Xplore, Science Direct, Google Scholar and ACM Digital Library. After all the individual searches, there were 1.057 articles available.

Aiming to make the reading less time-consuming and optimize the process, five filtering steps were performed, leading to 17 publications. As the main goal of this systematic review has been to evaluate applications directly related to the telecommunications industry, one last filter can be applied, considering only articles that have addressed telecommunications field operations. That leads to only one article, published by Ogushi et al. (2013) [1].

It could be verified that there aren't many publications available that actually address the use of augmented reality for the telecommunications industry. So, the authors found necessary to perform some tests on a commercial application, and the chosen one was AuGeo® [2].

IV. PROPOSED SOLUTION

It is important that the application makes use of embedded mobile sensors, such as GPS, to help determine the equipment location. A computer vision algorithm is needed to perform image recognition. Finally, information related to the equipment is shown right on the device screen.

The proposed system architecture is shown in Figure 2.

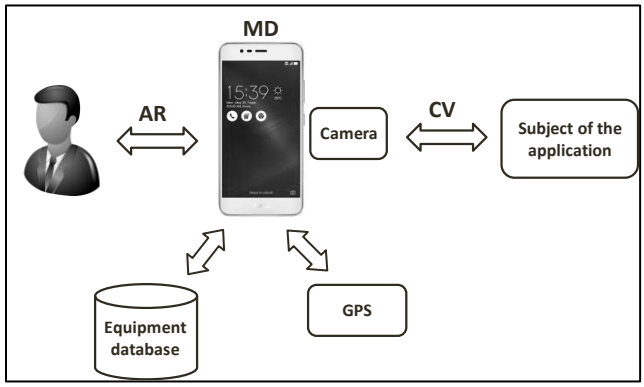

Figure 2: Proposed system architecture. The user captures an image of the desired object using the camera embedded in his Mobile Device (MD), which is a form of computer vision (CV). The system consults GPS data and a remote equipment database, fetches relevant information and presents it on the Mobile Device screen, using Augmented Reality (AR).

V. PRELIMINARY RESULTS

Through this systematic review, one came up with an important finding: there is a huge variety of applications involving image recognition and augmented reality.

Some issues have been reported by the authors, when working with these sorts of applications. One common limitation that has been noticed is the device GPS accuracy, in some cases. To solve this issue, instead of using GPS readings, some authors made use of object recognition through computer vision, or some kinds of artificial or natural markers. Regarding computer vision, some authors have reported issues with several object recognition models, for outdoor applications, so that system performance was not adequate. In other cases, the coordinates obtained from the GPS were the only parameter to determine location, and no method of computer vision at all was used.

The tests performed on AuGeo® application reaffirms the contribution that AR brings to the companies. The proposed system has a similar way of operation, but with some major differences: a) the database is dynamic, so integration with the company legacy GIS register is necessary and must be implemented; b) the technician will have the ability to perform some corrections (wrong coordinates or wrong names), through a feedback option available in the application; and c) the application will use computer vision to identify the object, in this case, the splitter. So, the final solution will combine both GPS and computer vision.

VI. CONCLUSION

This systematic review brought some concerns that must be exploited in the initial phase of the proposed application development. First, tests must be made to ensure that the GPS location itself is accurate enough to allow proper operation. Regarding the image recognition process, special attention is needed when choosing which algorithm for image recognition is the best, to ensure an adequate quality and waiting time. Finally, it must be checked whether the overall performance of the application is suitable for the technicians' smartphones, which are cheaper and not so powerful models, since they are provided by the telecommunications operator.

This study was helpful to confirm that the new application demanded by the telecom operator uses a new approach in the field, combining GPS data, a mobile device's camera, queries made to the company's existing equipment databases and also augmented reality, to increase workers productivity in a simple, smooth and accessible way, without radical changes to their working processes that could lead to rejection of this innovation.

Finally, by testing ESRI Labs' AuGeo® application, it could be verified that AR can be applied to a huge variety of applications and industries. Further exploration of AuGeo® functionalities is needed, in order to notice unattended needs, for the desired application for the telecommunications operator. Some other applications available will also be under testing, and compared to each other. Next, a first prototype will be implemented, and released to the company's technicians. Ease of use will be measured, and it will be possible to verify the need of adjustments. When a marketable version is reached, the increase of productivity and cost reduction will be measured, confirming the hypothesis that AR is a great ally for this industry.

REFERENCES

[1] Ogushi, I. (2013). Operation and maintenance work using AR technology for optical access networks, (Idm), 3–5.

[2] AuGeo® release note avaliable at: https://www.esri.com/arcgis-blog/products/3d-gis/3d-gis/ar-for-your-gis/