I. INTRODUCTION

The development and the usage of social media that continues to grow are followed by the increase number of digital devices under criminal investigation. This has caused major problems that affect the social media investigation process in order to present the results of a fast and precise analysis, and raises a challenge in social media investigative research (Pomalingo et al., 2019).

One type of Social Media is WhatsApp Messenger (WA). The last report on WhatsApp statistics (dating back to Q1 2020) stated the increasing number of WhatsApp Messenger users and recorded two billion monthly users over 180 countries as illustrated in Fig. 1. According to Koum & Acton (2016), WhatsApp Messenger is the most popular messenger application, followed by Facebook Messenger and WeChat. WA is supported by an encryption feature to ensure the data security of its users. However, the popularity and features provided by WA can be misused by the public for criminal purposes, for example in terrorism crime. Nevertheless, under forensically sound digital investigation process, the authorities can use the data in WA as evidence (Umar, Riadi, Zamroni, et al., 2018). To fulfill all the evidence to support the trial, the forensic team must present the evidence in a clearly and understandably manner for various groups, especially people who do not understand the digital forensics (Casey, 2011).

Forensic methods are needed to ensure the success of the process of retrieving these data, including the contents of text messages and where text messages are sent. The data is then visualized to get information about who is involved, time information, tracking activities, and timeline matching (Pomalingo et al., 2019).

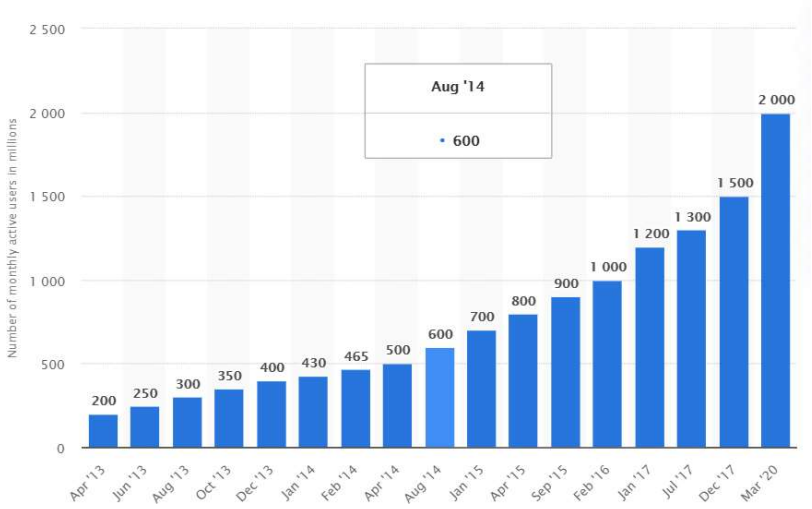

Fig. 1. WhatsApp users statistic (Clement, 2020)

In order to facilitate the illustration of the results of the WhatsApp investigation, this research develops a system using the Timeline visualization method. Timeline visualization is a method in which a series of events and visualization is recorded to present a series of events along a graph that has a time axis and place it at the point of time where something happens or the range where something ends (Plaisant, Milash, Rose, Widoff, & Shneiderman, 1996). In this research, the Timeline method is chosen from the many of visualization methods, because according to Nguyen, Xu, Walker, & Wong (2016) the Timeline method can help coordinate a series of events in a chronological dataset to facilitate the uncover temporal relationships and reduce the analyst's effort in memorizing an event. Timeline visualization usually uses rectangle graph or chart to show time of events and horizontal lines for 1 interval. This usually has an explanation of text that describes the event. To display the visualized data, it will represent with different colors, icons, or shapes (Plaisant et al., 1996).

A thorough forensic analysis has been done by Anglano (2014) on the WhatsApp Messenger application. The research analyzed WhatsApp Messenger artifacts on an Android device. Another research conducted by Yadav, Prakash, Dayal, & Singh (2020) discusses an analysis of the WhatsApp acquisition process that uses several tools, compare them, and show which application that is more suitable for forensic analysis in WhatsApp Messenger. There is also research conducted by C. F. Tassone, Martini, & Choo (2017) about the

visualization of the results of digital forensic analysis. They stated that visualization can be done by summarizing and narrowing the data needed to be observed by the forensic team. Based on this literature search, we found that currently there is no research related to the visualization of the results of an analysis of WhatsApp artifacts on an Android Smartphone, while visualization can be used as supporting evidence in some cases.

Therefore, this research proposes the visualization of the WhatsApp Messenger artifact that focused on chat database using the Timeline method that can support efforts in mapping data from various existing information for crime investigation purposes. The data visualization method in the form of a connected timeline graph is used to present the results of the analysis.