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Let the robots do it! - Taking a look at Robotic Process Automation and its potential application in digital forensics

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Abstract

The challenges of tackling increasing caseloads, large volumes of digital data and maintaining examination efficiency in order to adhere to tight criminal justice system deadlines persist. As the field looks towards techniques for improving efficiency, forms of automation are both simultaneously touted as a potential solution, whilst also attracting criticism. The potential for techniques which mechanise parts of the digital forensic examination process, and do it reliably, is great, however developing the capability to do this remains a challenge. This work provides an introductory discussion to Robotic Process Automation, a form of service task automation. It's potential application is debated and two case studies are offered demonstrating potential areas of applicability. An objective evaluation is offered, debating whether technology has a place in improving efficiency in this field.

Keywords: Digital Forensics; Robotic Process Automation; Investigation; Automation

1 Introduction

The demands placed upon the field of digital forensics (DF) are great. Now, digital evidence provides investigative support in many criminal investigations, requiring the involvement of specialist practitioners to extract, process and report this content. Without retracing well trodden ground, many of the issues facing DF practitioners has remained the same for the last 10 years; budget restrictions, diversity of devices and increase in the volume of digital data requiring processing to name but a few. When distilled, the challenge for the discipline of DF is to take available resources and deploy them in a suitable, efficient manner allowing the timely investigation of digital exhibits whilst operating within a difficult, constrained environment. The ability to process digital data quicker, with sustained accuracy and reliability has remained a long-time goal of research in this area; work seen as having the potential to increase efficiency and keep pace with the demands placed upon practitioners by criminal justice processes in the case of criminal work. As a result, much comment has been offered with regards to attempts to automate specific aspects of the DF investigatory process (see Stallard and Levitt, K., 2003; Carrier and Spafford, 2005; Case et al., 2008; Beebe, 2009; Garfinkel, 2009; Scholtz, 2010; Cantrell et al., 2012; Hargreaves and Patterson, 2012; James, and Gladyshev, 2013; Mohammed, Clarke and Li, 2016; Homem, 2018), ranging from case and results processing and the sifting and categorisation of results, to triage procedures which involve forms of evidence identification. The work offered in this article falls within the category of automation to support case processing.

Whilst forms of automation offer the potential to increase productivity, suggestions have also been met with criticism, where such techniques may be negatively associated with the terms of 'push button forensics' and 'Nintendo Forensics' (Carvey, 2005; Read et al., 2016; Butterfield et al., 2018). There is a balance to be struck (and arguably yet to be done so) with regards to the incorporation of provision which automate forensic processes. Whilst the promise of speed of

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processing to support the practitioner is one which would most likely be welcomed by most, it is offset against the worries of potential missed evidence (Caviglione et al., 2017). As a result, the scope of incorporation of automation into any forensic processes must be strictly defined to limit potential issues.

This work offers the first discussion of Robotic Process Automation (RPA) for use within the DF environment, and at the time of writing, there are no academic commentaries available documenting the use of RPA in this context. An objective assessment of its worth in the DF process is provided and two case studies are presented demonstrating RPA functionality and integration with mainstream forensic tools.

2 What is Robotic Process Automation?

RPA is the automation of service tasks that were previously performed by humans. Madakam, Holmukhe and Jaiswal (2019, p.4) describe RPA as an '*emerging form of business process automation technology based on the notion of software robots or artificial intelligence (AI) workers. RPA has become the new language of business. This technology is more powerful among the 21st century technologies*.'. UiPath (n.d.) describe RPA as 'technology that allows anyone to configure computer software or the "robot" to emulate and integrate the actions of a human interacting with a computer to complete tasks'. The "robot" allows for repetitive tasks to be performed accurately by interpreting the application, this is when the RPA programme performs the instructions set by the developer by communicating with the systems using on screen recording and variables. Then it triggers the response to produce results. These actions include logging into applications, copying and pasting data, opening emails, filling out forms and many other actions performed on a computer. Essentially, van der Aalst, Bichler and Heinzl (2018) state, 'RPA is an umbrella term for tools that operate on the user interface of other computer systems in the way a human would do'. RPA is already in operation in multiple businesses, some success stories taken from UiPath (2019) were Ladbrokes Coral, EDF energy and Department of Work and Pensions. The success these companies have gained is from the return of investment. Companies opting to use RPA software need to invest money into the technology at first, but over time it becomes very beneficial as they will soon start to see profit. A study of Telefónica O2 was conducted in 2015 by (Lacity, Mary C. 2016) looking into the factual benefits of RPA technology implemented into the backend processes of the business.

RPA works through the use of a programmed 'robot' which has been configured for task completion (see Figure 1). Following the identification of a software-based task which can be procedural replicated, RPA products can be utilised to program a robot which can carry out the same sequence of software interactions needed for task completion. As a result, RPA is best suited to procedural styled tasks which are consistent and repetitive. It is necessary to differentiate RPA from traditional forms of process automation such as screen recording, scraping and macros, which are typically considered traditional forms of automation and the starting point for this technique (Jacada, 2019). RPA's core function is via element identification within an interface. Therefore it is not limited by screen coordinates, which provides for a more 'intelligent' and dynamic interaction with a graphical user interface which can connect different interface elements together (Jacada, 2019). In comparison, older methods of automation may

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rely on screen resolution and screen positioning of specific icons/buttons to remain in the same location, so that the can be found on a consistent basic by any automotive process.

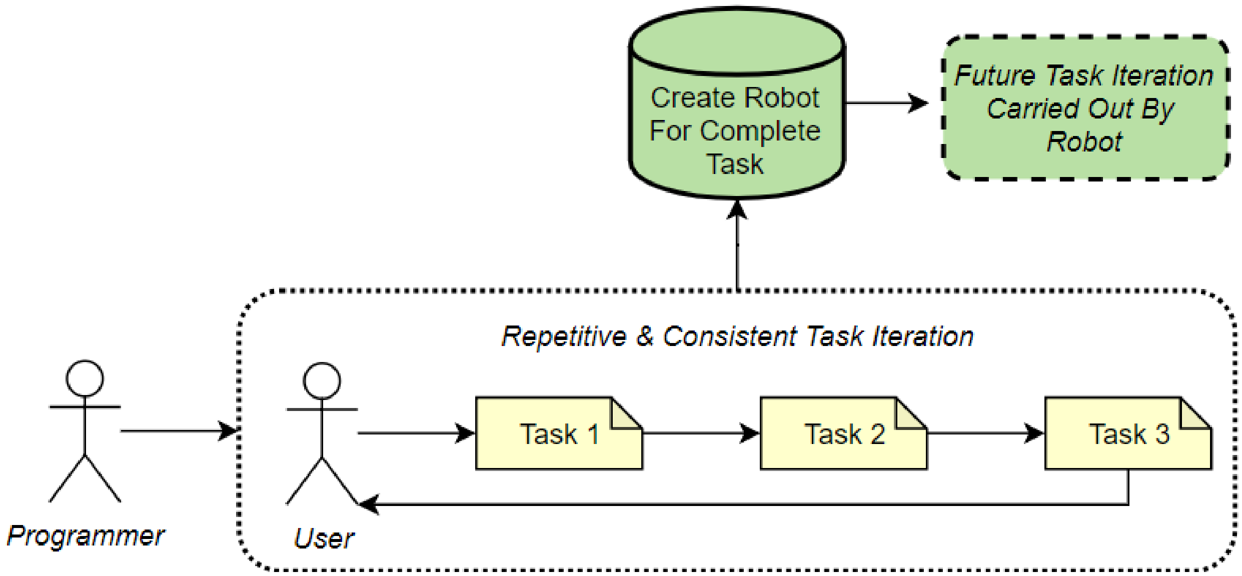

Figure 1: An overview of RPA and robot development

One of the benefits of implementation of RPA software is that it only interacts with the presentation layer of software; that which humans can see. This layer deprives from the seven-layer OSI (Open Systems Interconnection) model (Rouse, 2018) used to describe how applications communicate over a network. The presentation layer performs data translation, compression and encryption between applications. For RPA this means interacting with the programme once it is in a human readable format.

2.1 Differences between Automation and RPA

Traditionally automation relies on Application Programming Interfaces or APIs and other integration methods to integrate different systems. This means a developer must have a good understanding of how the system/application works before integration can take place. However RPA does not integrate with the software it operates with, it interacts at a human level (clicking buttons, typing into text fields etc.) As a result, RPA can only work as fast as the application works as it sits on the presentation layer.

2.1.1 Benefits

In contrast to other traditional IT solutions RPA allows for businesses and organisation to automate at a lower cost with less time to implement. RPA also does not disrupt underlying systems as it performs tasks as a human would meaning no downtime for a business's thinking of implementing RPA software. What this means in context for DF, is that RPA offers a potential cost-effect solution which theoretically can be implemented on top of any existing software solutions with in a laboratory, causing minimal disruption to existing processes. The main benefits of RPA technology outlined by Buccowich, (2019) are accuracy, improved employee

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morale, productivity, reliability, consistency, non-invasive technology, compliance and a low technical barrier. These have been contextualised for DF below.

Accuracy: RPA allows for consistency, and arguably it is less prone to procedural errors (mistaken implementations of a procedure) which may occur from a human performing the same set of tasks. Therefore, providing that any robot has been correctly programmed with its functionality tested and verified, it will perform the task with consistent provision. Any variable changes result in a process failing to complete, flagging notable errors to the user which indicates that a process has not been completed as expected. As a result, a robot which is designed to carry out a task should carry out this task accurately or where this cannot be achieved suitably notification is provided to the user. In doing so a high level of reliability can be placed upon the procedures undertaken via RPA as there is limited margin for a robot to deviate from its allocated tasks.

Productivity: Productivity is potentially increased due to the fact that the “robot” process cycle times are much faster compared to manual process approaches (see Figure 2). Even where a technician may be well versed in running specific tasks, an RPA approach is likely more efficient as computational speeds exceed those of an individual interacting with a computing device. In turn, this frees the technician from this roll, allowing engagement with more investigative work. RPA “robots” can work all day every day without interruption. Therefore scheduled assignments can target processing times where resources are free or processing power is available (for example, overnight, allowing results to be available for practitioners at the start of a shift). Therefore procedural tasks needs to be confined to standard working day patterns, where commencement of robot processing can be schedules across all hours to obtain maximum processing benefits from existing infrastructure and resources.

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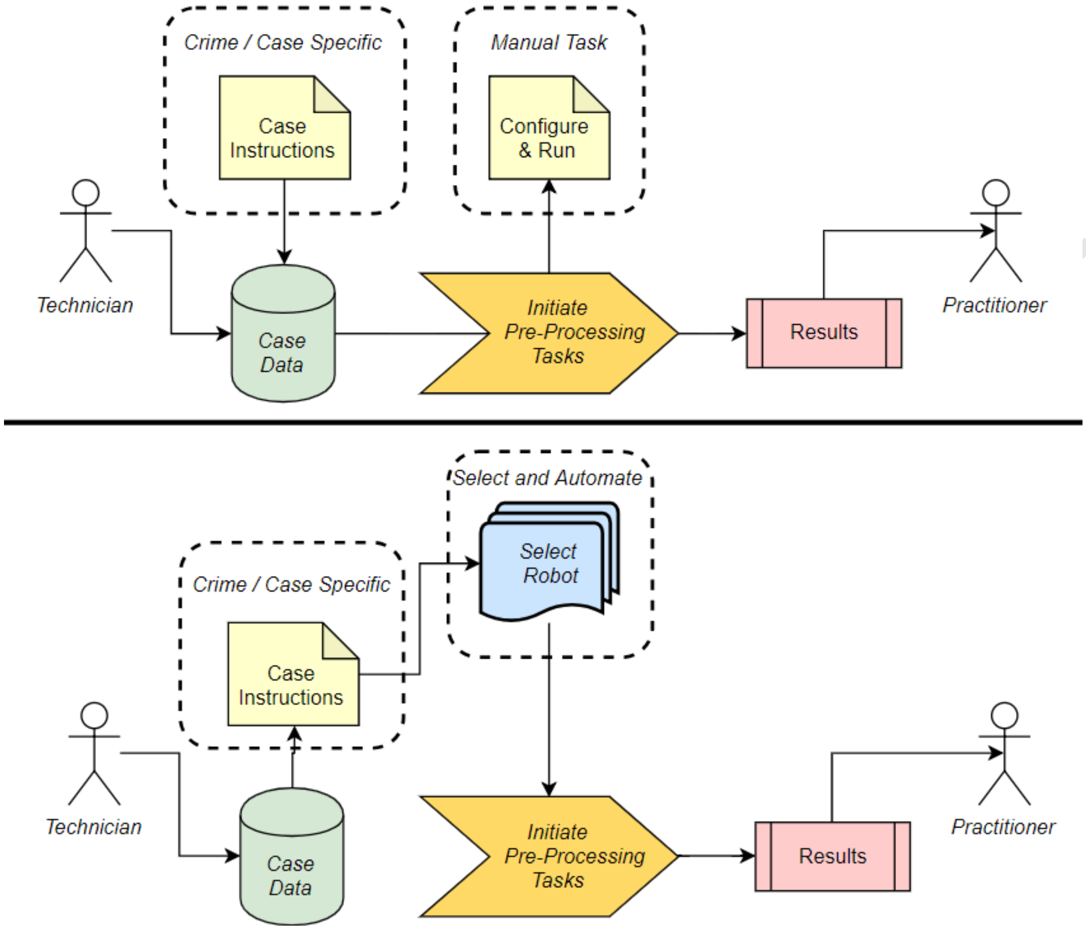

FIgure 2: A demonstration of the use of 'robots' to implement tasks

Consistency: One of the major benefits of RPA is that routine tasks can be performed the same way each time an implementation occurs. As robots can only carry out pre-programmed commands, unexpected task deviation is not possible. This is an important factor as it allows any results to be checked also helps to instil trust in any process. Therefore whilst performing the task accurately (as noted above) is important, if the robot is programmed correctly, consistent implementation should be a natural byproduct.

Non-Invasive Technology: This means there is no disruption to underlying IT systems or forensic applications. RPA sits on top of the application and interacts with it in the same way a human does. Providing that any underlying forensic software is compatible with any RPA platform, interaction can occur without any disruption to existing processes.

Compliance: RPA "robots" follow regulatory compliance rules as they can only operate through a sequence of actions. If a company has a policy or standard that must be followed when conducting an action RPA technology can conform to this as it is created by an employee who will know the procedure. It can also provide an audit trail history of the actions it has taken as

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well as recoding details if something does go wrong. This allows for user to find issues quicker and allowing for the robot to meet stricter compliance standards. In the context of DF, this means that on completion, the actions of a robot can be vetted to determine task success rates.

Low Technical Barrier: Despite requiring some level of upskilling (as with all unknown technological deployments), RPA offers a relatively low entry point. No programming knowledge is necessary to configure a software robot (Granta, 2017). For example, UiPath uses flowchart actions to create a process by recording on screen actions.

2.2 So where could it fit within digital forensics?

Tasks which automate (or attempt to do so) DF processes are generally met with cynicism and concern (James and Gladyshev, 2013). The idea of trusting automatic processes in criminal cases where the risks remain high and personal freedoms are at stake is difficult. Yet providing the tasks which are automated are confined to specific objective functions where results can be vetted and the accuracy of task completion can be assessed, the risk remains somewhat low. FIgure 3 provides a distinction between the types of task where RPA may offer low-risk benefit to DF.

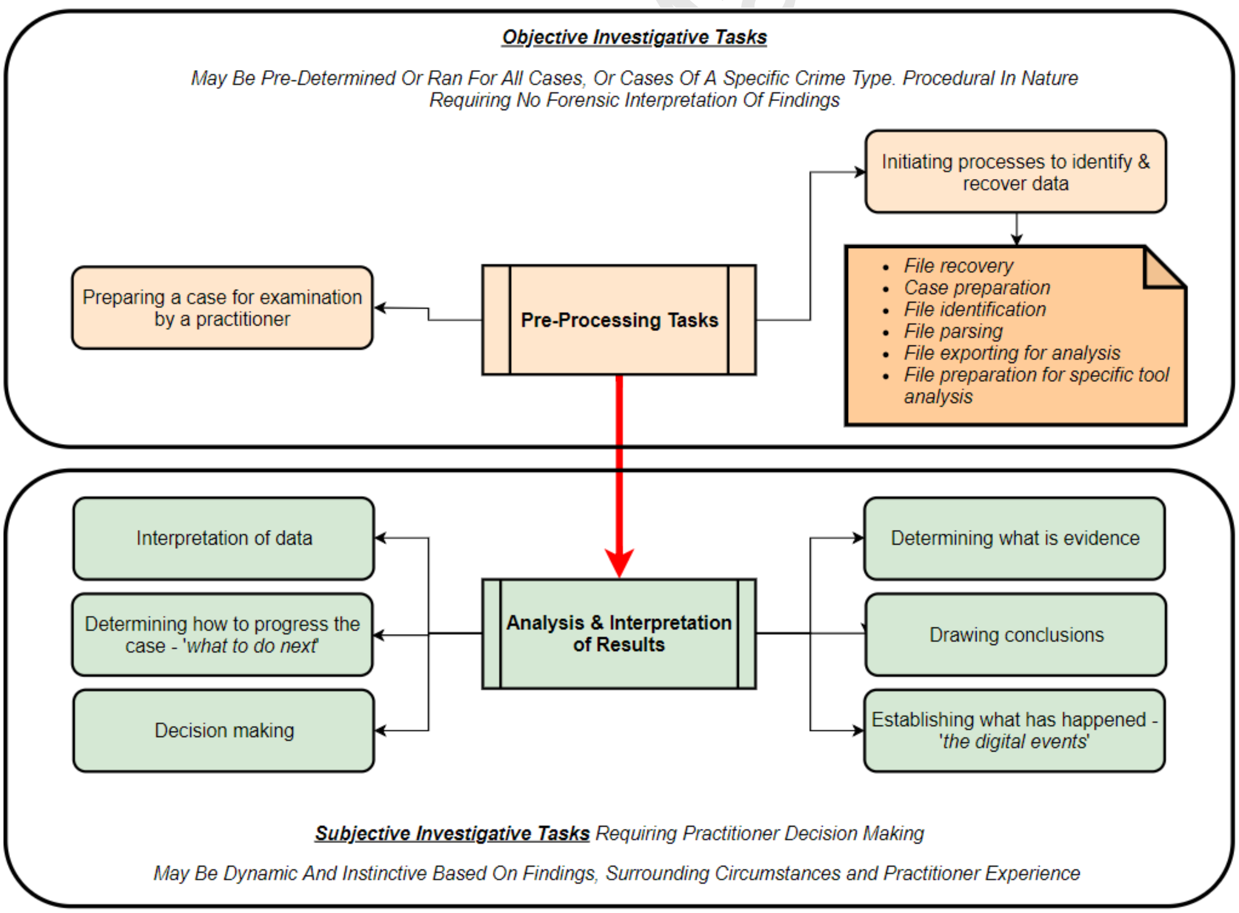

Figure 3: A distinction between pre-processing tasks and investigative tasks (high resolution image attached as a separate file to manuscript).**

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To begin the discussion, it is necessary to define where RPA does not have a role in DF. This can be loosely defined as any subjective investigative task which requires any analysis and interpretation of findings and ultimately, decision making. RPA is not intelligent, it operates basic iterative logical tasks. Therefore, it has no place in the stages of an investigation where findings are subject to scrutiny and it cannot replace any practitioner reasoning at this point in an investigation.

Where RPA may have a role to play likes with data processing, handling and presentation. These are the objective tasks of any DF investigation, often categorized as 'pre-processing' tasks. These of the functions that are carried out prior to any data analysis, where data is recovered, parsed and prepared for interpretation by the practitioner. Such tasks include running crime-specific keyword lists, importing multiple exhibits to a case, running file carving scripts, performing hash analysis or exporting/importing specific files for analysis in a bespoke platform (see for example, image-analysis in Griffeye for cases involving indecent imagery of children). These objective tasks require no interpretation. To be of use to a DF practitioner, the task must simply be initiated correctly and complete with no errors.

2.3 Caveats

Whilst RPA carries the aforementioned benefits, it is also necessary to define the limitations of its successful implementation, noted as follows:

Compatibility: Whilst RPA carries the benefit of 'sitting on top of' existing software and its user interface, there are still compatibility issues to consider. Any robot must be able to interact with the components of an interface, but the ability to interact depends on how the interface is coded (which in some cases is not disclosed by the vendor). Table 1 highlights a list of tools tested for UiPath compatibility. Compatibility provides a barrier to RPA adoption in DF, where the impact of this is difficult to ascertain due to limited available information noting the extent to which each DF software application is adopted in an investigatory capacity world-wide. What Table 1 potentially demonstrates is that depending on what tools are available in any given DF lab, RPA implementation may not be possible for everyone. However to assess the validity of this statement, additional RPA tools must be tested in order to establish to a greater extent the issues of compatibility and this is recommended future work. It should however be noted that if automation can be seen to reduce time/workloads and increase productivity, then DF organisations may move towards RPA compatible platforms. Alternatively, DF software platforms may seek to ensure their interfaces are RPA compliant in order to facilitate such techniques.

Table 1: A breakdown of compatibility with UiPath

Tool	UiPath Compatible
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Autopsy	Yes
X-Ways Forensic	Yes
EnCase v8	No
Magnet Axiom	No
Griffeye	Yes
XRY	Yes

Cost: With any new technology implementation there will be a cost involved. Whilst UiPath offers a free community edition to test the software, commercial stage application requires a paid licenced solution. However resource acquisition in many cases is dynamic, analogous to cloud service models.

Time to program: Before RPA begins to provide procedural benefits, time must be spent upfront to program their functionality. This also means that an organization must have the relevant expertise in-house to do this as well as identifying suitable areas for robot application.

The need for good housekeeping: RPA is procedural by nature and therefore any DF must maintain good, consistent organisation within their digital structures. We term this as ‘good housekeeping’. This essentially means that as long as default locations for finding and storing relevant content remain consistent, there is less likely to be issues with robot utilisation. Where file paths and naming conventions to relevant content is non-consistent it is more difficult for robots to be programmed in a way that allows tasks to be repeated without procedural errors occuring. Therefore there is a strong emphasis on determining and implementing organisational good housekeeping, before RPA offers any advantages in task repetition.

3. RPA In action

There are multiple RPA platforms available with market leaders including UiPath (n.d.), Blue Prism (2018) and Automation Anywhere (n.d.). For this work we have opted for the UiPath platform who define themselves as the leader in enterprise RPA. UiPath operate a free community platform and licensed paid-for solutions are available.

To demonstrate the use of UiPath robots, Section 3 is split into three sections. The first section provides a demonstration of a robot carrying out a keyword search on the forensic platform Autopsy. Section two provides an example of a robot being utilised to import evidence files into the forensic platform Griffeye for processing and image extraction. FInally, section three provides a ‘behind the scene’ demonstration of how the robots are constructed and programmed, providing an overview of the creation process.

Due to the complexity of the UiPath robots, we have opted to supplement our discussions with video content showing the robots in action.

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3.1 Case Study 1 - Autopsy Pre-Processing Tasks

For the first case study demonstrated in this work, a robot has been created to interact with the Autopsy forensic software and carry out keyword search by initiating the keyword search ingest module (an overview of the process components is shown in Figure 4). Video 1 provides a walkthrough of the components of the robot in action.

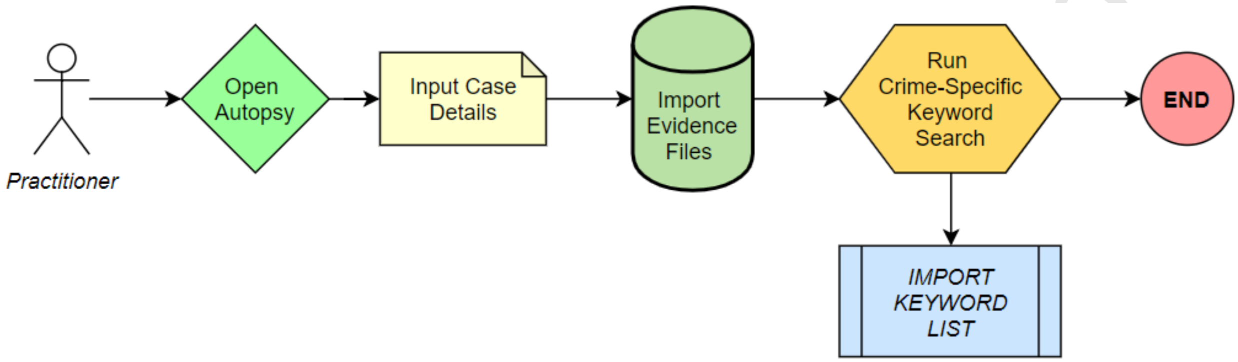

Figure 4: An overview of the RPA stages in Case Study 1:- Autopsy Pre-Processing

****Video 1: A demonstration of the robot interacting with the Autopsy platform (separate video file submitted with manuscript).**

3.2 Case Study 2 - Loading Content into Griffeye

For the second offered case study, a robot has been created to interact with the Griffeye forensic platform, import evidence files for processing and carry out image extraction processes demonstrating pre-processing for tasks commonly associated with cases involving illegal imagery reviews. (an overview of the process components is shown in Figure 5). Video 2 provides a walkthrough of the components of the robot in action.

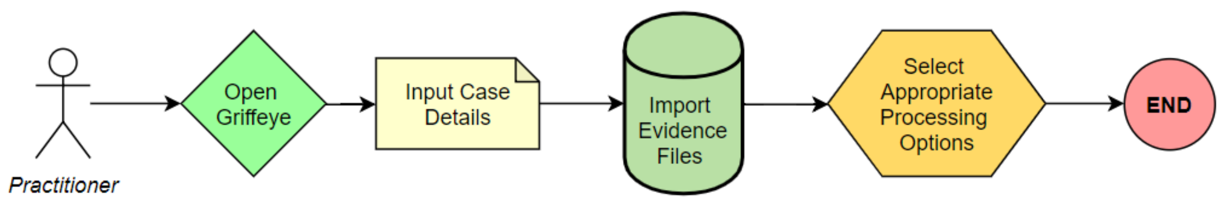

Figure 5: An overview of the RPA stages in Case Study 1:- Griffeye processing

****Video 2: A demonstration of the robot interacting with the Griffeye platform (separate video file submitted with manuscript).**

3.3 How the robots are built

Whilst sections 3.1 and 3.2 have offered a demonstration of robots in action, their construction requires discussion. In UiPath, robots are created as a flow chart of events with interaction sequences (see Figure 6 for an example). For example, a robot maintains a start and end point,

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with notable events or 'actions' which it must undertake along the way. For example, as shown in Figure 6, our robot has an event of 'open new case' and in order to do this, it must follow a sequence of interactions including select the 'case' menu followed by selecting the 'new case' element. These actions and sequences are chained together to form the robot's complete functionality. Robots are configured to carry out these actions either being coded to do so, or via 'screen recording'; a function which captures the mouse movements and clicks of a user and re-implements them in future iterations of the robot. Due to the complexity of robot construction, further demonstrations are offer in video form, where Video 3

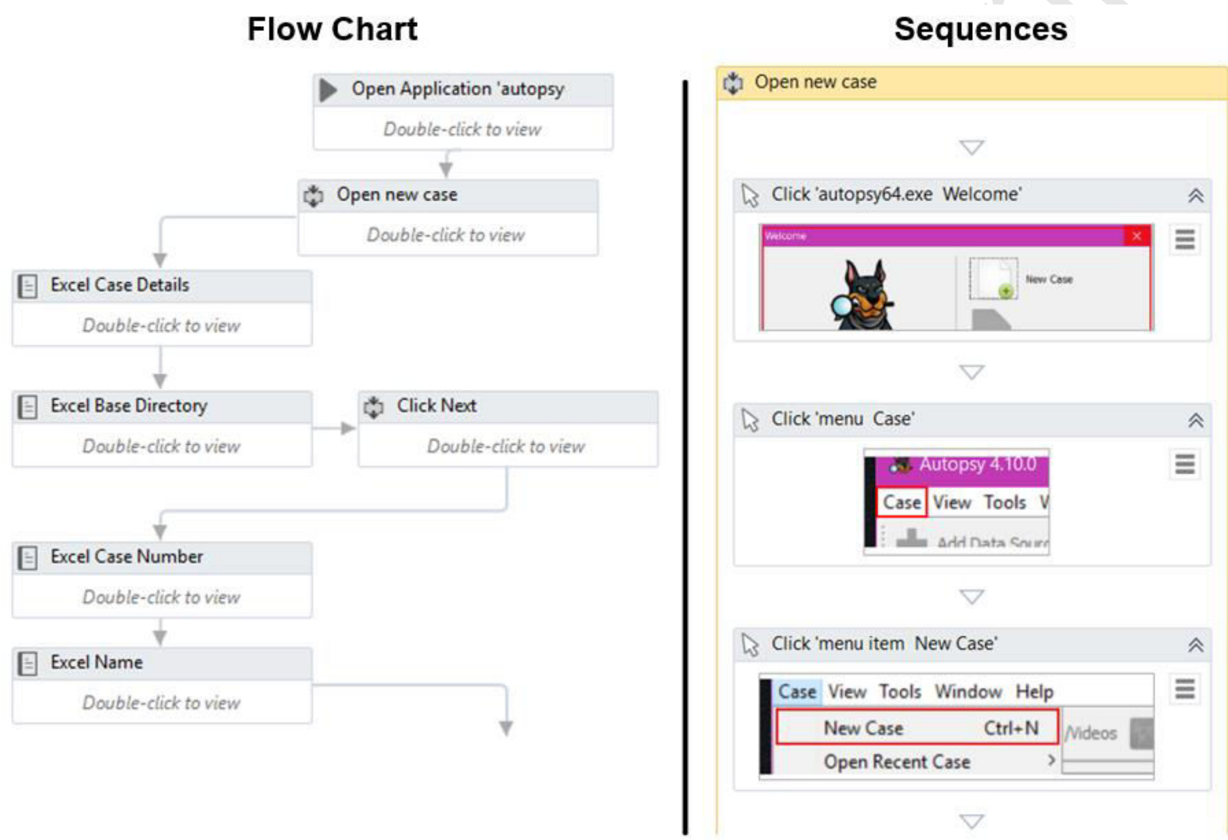

Figure 6: Flow Chart and Sequence events in robots

****Video 3: A demonstration of how robots in UiPath are built (separate video file submitted with manuscript).**

4 Concluding Thoughts

It is necessary to start by stating that this work neither champions or condemns the use of RPA in the field of DF. The authors aim to have provide an objective examination of the technology and how it may be implemented within this context. From the cases studies provided, it has been demonstrated that RPA can carry out some of the basic pre-processing tasks undertaken in DF, however, their implementation requires specific planning within an organisation to ensure that the digital environment is suitable for its use (for example, ensuring consistent organization of files/content is in place and maintained). RPA does not adapt well to structural change and if

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it occurs, robot-reprogramming may be required. Implementation of RPA is going to be limited as previously established in Table 1, UiPath incompatibilities exists, therefore those organisations which do not operate compatible forensic software may not be able to utilise RPA as a technique. A limitation of this work remains that focus was only given to UiPath as a proof of concept case study and further work using different RPA packages is required in order to identify the full extent of forensic software coverage available.

RPA is also a form of attended automation; an element of human interaction is still required to trigger a robot and to address content upon its completion. From the viewpoint of a DF organisation this may be seen as a good thing as oversight of the process is maintained. It should be noted that each robot maintains an audit trail of its function so vetting of the process can take place *post mortem* should concerns exist regarding the accuracy of its running.

Adopting RPA as part of standard DF casework processing is arguably going to take a change in organisational attitude. Tasks which are the target of RPA are those which have often been completed traditionally by DF technicians or junior practitioners. RPA may offer to some extent the ability to free up their roles to undertake more investigative tasks. An acceptance to automate is needed, and this position appears to be beginning to be viewed more favourably (Al Fahdi, Clarke, and Furnell 2013)

4.1 Going forward

In order to establish the potential value of RPA in DF, further testing of this technology is required going forward and the following areas are specifically highlighted:-

- Whilst this work establishes that RPA usage is possible, defining its full capability and therefore value is required. This requires both further and continued testing regarding interaction features, and the identification and development of investigative tasks which are deemed suitable for RPA.
- Further robot design is required, increasing the complexity of procedures and establishing capability limitations. This will help to establish the limited of RPA applicability in a DF capacity and help to identify how involved RPA can become in DF processes.
- Testing of additional RPA platforms is needed to establish capability across the RPA field. This work has examined UiPath, and more work is required to evaluate the range of available RPA tools and their functionality within a DF context.
- Limitation studies are also required, defining why RPA may not be compatible with certain types of software interface and any impacts this may have.
- Whilst RPA is designed to consistently iterate tasks, indepth DF evaluations are required to assess in-context reliability.

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No conflict of interests – but please note I am section editor for Digital Foreniscs

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