Towards Improving the Usability of Password Managers

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1. Introduction

Security mechanisms are only effective when used correctly [24]. Effective use of text passwords requires choosing hard-to-guess passwords, which is a challenge to users [22]. Password Managers (PMs) address this challenge but their adoption is still low, partly due to a lack of trust and usability [1].

This work is part of the **PassCert project**, which aims to build a formally verified Password Manager, and our goals are to:

- improve the usability of the PassCert PM;
- investigate ways to convey to users the formally verified properties;
- determine if formal verification increases users' trust in PMs.

2. Challenges of PMs

Despite security experts recommending the use of PMs [5], they are not widely used [1]. Below, we present some problems and proposed solutions:

PMs challenges identified	Proposed solution from literature
Lack of trust and understanding [12, 17, 20]	Provide a higher level of transparency [20]
Lack of motivation to use PMs [1, 13, 17]	Educate users about the benefits of using a PM [4, 13, 16]
Bad performance, poor integration with other applications [20, 22]	Solid and bug-free implementation of all features [20, 22]
Difficulty of use (lack of usability) [1, 2, 4, 15, 16, 20]	Simplify the interface and provide support for users [2, 4, 20]

3. Extending Bitwarden & Main Improvements

The PassCert project is using Bitwarden [3] as a basis for creating a proof-of-concept PM that, through the use of formal verification, guarantees properties on data storage and password generation [10].

Below we describe four major extensions done to Bitwarden:

1. New Icon Signalling Formal Verified Features

To help users become aware of the formally verified features of the PM, we designed new icons to represent formal verification (Fig. 1). The icon is distributed throughout the interface where a feature is formally verified.

Fig. 1 - Formal Verification Icon

2. Explanations about Formal Verification

When the formal verification icon is clicked, a contextual description about the formal verification of that specific feature is shown (Fig. 2 and Fig. 3).

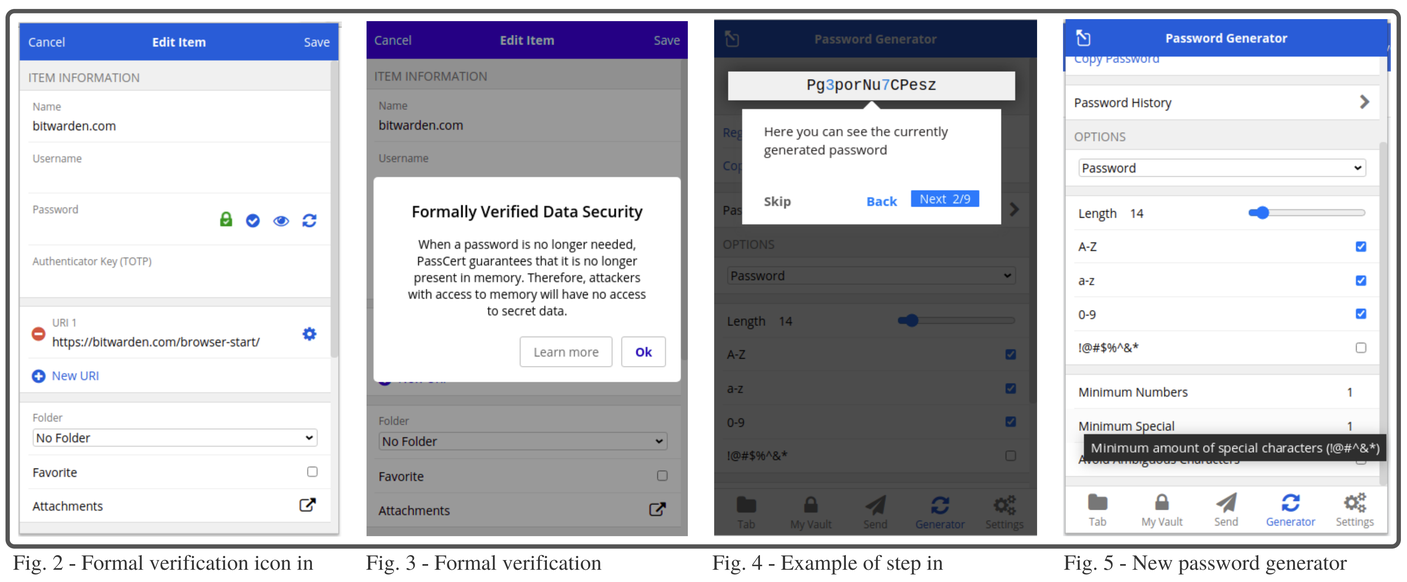

Fig. 2 - Formal verification icon in the password field

Fig. 3 - Formal verification information

Fig. 4 - Example of step in walkthrough tutorial

Fig. 5 - New password generator tooltip

3. Additional Information via FAQs and Tutorials

To convey information about relevant topics, we designed a FAQ and a tutorial (Fig. 4).

4. Improved Tooltips

We categorized existing tooltips in Bitwarden as *Well implemented*, *Non-descriptive*, or *Missing* (Fig. 5). Tooltips of the last two categories were improved or added.

4. Preliminary Results

1. In **a study with 25 participants**, the icon that users perceive as the most adequate to signal the formal verified features is the one shown in Fig. 1.

2. We have performed **pilot tests** to refine the testing protocol and script. The main insights are:

a. Users need space to explore the interface. Further studies will begin with a tour through the PM's tutorial.

b. Even though one of the users stated knowing what formal verification is, they were not able to identify how it was used in PassCert (but associated it with security).

5. Conclusion & Next Steps

A major problem identified in PMs is lack of usability [1, 2, 15, 20]. In this work:

- We reviewed usability challenges of PMs and proposed the use of known usability best practices;
- We have identified usability problems in Bitwarden and described several extensions already implemented;
- We carried out pilot studies to gather preliminary results regarding icons choices and usability;
- The next immediate step is to perform more in-depth user studies to learn more about users' understanding of formal verification and PMs.

6. References & Paper

https://passcert-project.github.io

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