

StoryStick++: Rethinking Measurement In The Maker Age

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Abstract— *StoryStick++ is a digital measurement tool that modernizes the traditional story stick used in woodworking. It combines a programmable LED-ruler with a smartphone interface to provide real-time, project-specific visual marking guidance. By eliminating numeric readouts and instead showing users where and what to mark, StoryStick++ helps prevent common measurement errors. This system lowers the cognitive burden of manual measurement and acts as a "dynamic story stick" tailored to each digital design uploaded by the user.*

I. INTRODUCTION

Measurement mistakes are one of the main sources of errors when building, prototyping, or manufacturing a physical artifact [1]. Traditional tools like tape measures and rulers require careful reading, proper alignment, and often involve intermediate calculations. These processes are vulnerable to mistakes, especially among novice users. In contrast to the greater success in engineering and metrology of studying and improving technical aspects of measurement, such as accuracy, cost, and speed [2], the user aspects of measurements and handling dimensions have not received as much attention.

Despite measurement tools being technically accurate, users still make mistakes during layout tasks because of the usability issues before, during, and after the act of measuring. These stem from a lack of thoughtful, user-oriented design. As a first example of how digital sensing and communication techniques can help reduce measurement errors, we revisit the traditional story stick and explore how it can be reimaged to better support the user. Story sticks are simple wooden planks with manually applied notches that encode multiple measurement references for a specific design. Aligning the stick with the workpiece allows markings to be transferred directly, enabling fast and repeatable layout work without relying on numbers or standard units, which are error prone. However, traditional story sticks have critical limitations: they are inflexible, tailored to a particular design, and dependent on the maker's memory to interpret their markings correctly.

II. RELATED WORK

Digital measurement tools and interfaces have been explored in both HCI and metrology. Novel systems and interaction techniques developed in Human-Computer Interaction (HCI) are increasingly shaping measurement practices within the prototyping workflow. For instance,

some systems seamlessly integrate measurements into CAD models [3], while others explore gesture-based or body-relative measurement techniques [4]. Additionally, IMU sensors enable automatic digitization of measurements [5], and alternative approaches such as building blocks [6], jigs [7, 8], visual augmentations [9], and 3D scanning [10] provide ways to bypass traditional measurement tools altogether. These advancements reflect a broader shift toward intuitive, adaptive, and integrated measurement approaches, reshaping how makers and engineers engage with physical dimensions.

III. STORYSTICK++

Story Stick++ is a reusable layout tool that combines physical guidance with a digital connection to CAD. This way, users can follow step-by-step measurement instructions that are directly linked to the digital design. Unlike traditional story sticks, which rely on memorizing the meaning of the marks, StoryStick++ makes the underlying "story" behind each marking explicit, and it features a dynamic scale where marks can appear when needed and disappear afterward.

StoryStick++ encourages sustainable making by reducing material waste. It enhances accessibility by reducing the cognitive demands traditionally associated with measurement. By shifting to a guided marking process, the system empowers users with varying levels of spatial ability. As a smartphone-powered device, it uses familiar, widely available consumer hardware, instead of using proprietary or specialized systems.

A. Core Design Elements of StoryStick++

Unit-less measurement : The system removes dependency on standard units by directly guiding users to the correct marking positions.

Contextualized markings : Each marking is enhanced with visual and semantic context from the design, making every measurement self-explanatory and easier to interpret.

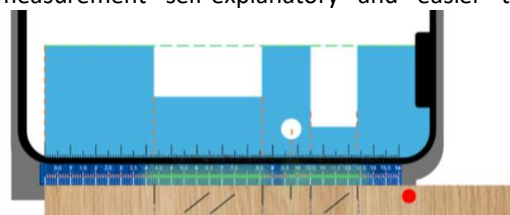


Figure 1: Replicating a 2D drawing with StoryStick++

Hardware-software integration: A physical LED-ruler based scale is tightly coupled to software that parses CAD-like schematics.

Built-in measurement etiquette: Best practices such as correct alignment are subtly enforced through step-by-step guidance integrated into the workflow.

B. StoryStick++ working principle

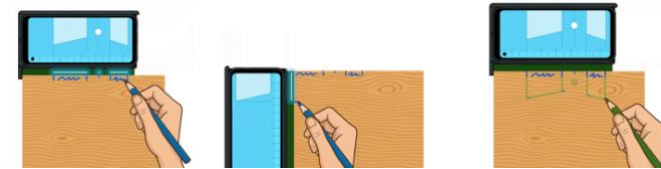


Figure 2: Working Principle StoryStick++

The process starts with uploading a digital schematic, such as a CAD or vector drawing. The software then analyses this input and segments it into a clear sequence of layout instructions. As the user aligns the device to the workpiece, the app guides them through each marking task by highlighting exact positions with the dynamic LED-scale.

IV. EXISTING PROTOTYPE

A. Hardware Design

The StoryStick++ prototype consists of a custom-designed ruler with a 1 mm resolution, featuring an array of addressable SMD LEDs. These LEDs are individually controlled via a series of shift registers and managed by an integrated microcontroller, which also handles UART communication with the connected smartphone.



Figure 3: StoryStick++ PCB

The hardware is designed to be mounted to the back of a smartphone using a compact 3D-printed bracket. Power is supplied directly via the smartphone's USB port.

B. Software Design

The accompanying smartphone app serves as the user interface. It accepts 2D vector input (e.g., SVG files exported from CAD tools) and processes them into marking instructions. The app interprets dimensions and layout features from the file and communicates with the LED-scale over UART. Each LED lights up according to the uploaded plan, guiding the user either through multiple markings at once or in a step-by-step workflow.



Figure 4: Measurement guidance with StoryStick++

V. AUTHOR BIO

As both a maker and an engineer, I believe that the ability to create personal, sustainable objects is becoming increasingly valuable in a world shaped by mass-produced goods that often lack creativity and durability. Through hands-on experience in woodworking and leathercraft, I've seen how even small measurement errors can lead to material waste and unsatisfying results. StoryStick++ emerged from a desire to rethink measurement tools, not just as instruments of precision, but as user-centered aids that support novice makers, reduce cognitive load, and refocus attention on the creative process rather than technical complexity.

StoryStick++ was developed during my Master's thesis at the Digital Future Lab at UHasselt, within the Computational Design and Fabrication unit led by Dr. Raf Ramakers, a lab known for its strong focus on human-centered design.

VI. FUTURE WORK

Future work will focus on developing a broader range of novel measurement tools inspired by the same principles that led to the creation of StoryStick++. Central to this is the ability to interpret CAD drawings and generate step-by-step layout instructions that users of these tools can follow. We will also explore unit-less techniques, both to guide physical layout tasks, but also to capture and digitize measurements directly. We will also explore ways to determine the position of the measurement instrument relative to the workpiece, as this spatial awareness is crucial for delivering accurate, context-aware feedback and guidance during the measurement or layout task.

VII. REFERENCES

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