MiniBUG: From Concept to Production in a Prototyping System

Alicia Gibb
R&D
Bug Labs
New York, USA
alicia@buglabs.net

Robert Faludi
Interactive Telecommunications Program (NYU)
New York, USA
rob@faludi.com

Dan Steingart
Department of Chemical Engineering
(CCNY)
New York, USA
dan.steingart@gmail.com

ABSTRACT
Bug Labs [1] is an open source company attempting to democratize innovation through Linux-based prototyping devices. To scale our product line we recognized certain factors that needed to prioritized: functionality, connection, shape and size, and economics. While three of these factors were addressed by the original BUGbase, the original unit is relatively expensive. At a cost of roughly $800, the BUGbase is beyond the reach of many prototypers [2]. MiniBUG is in development—a smaller unit with a streamlined feature set and sale price of less than $100. This work represents the critical assessment of the original unit and the resulting miniBUG unit. The research collected was used to reflect on the process of designing miniBUG while considering price point, flexibility, affordances in the functionality, and the usability of the complete system.

Author Keywords
Bug Labs, miniBUG, prototyping systems

ACM Classification Keywords
Hardware

General Terms
Design, Experimentation

INTRODUCTION
The miniBUG modular computing platform [3] is in development at Bug Labs in conjunction with Robert Faludi of NYU's ITP program and Dan Steingart of the Department of Chemical Engineering at the City College of New York. MiniBUG is a prototyping platform meant to streamline the evolution of a proof-of-concept to a production device. The industry lacks an inclusive system that goes from prototype to pilot to production, though there are many choices for toolkits and microcontrollers with a prototyping focus [4]. We will share the exploratory nature of developing the miniBUG system and explain the design flow of using the miniBUG to get from an initial prototype to a production level device. MiniBUG is being developed as part of the Test Kitchen [5], Bug Lab's open R&D lab, thus the process itself is open.

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THE PROCESS OF DEVELOPING MINIBUG
For several years we have observed [6] the difficulty DIY physical computing prototypes face making it into a pilot or production phase, especially in academia. It is notoriously challenging for prototypes to reach a wide-scale distribution channel [7]. The miniBUG system incorporates a process to accommodate the manufacturing and distribution of DIY and physical computing projects, giving developers the ability to turn prototype units into pilot or production units. Similar to the research-practice gap [8], in which Norman identifies a problem of researchers moving from research to development to a business practice, MiniBUG hopes to transition users from a prototype to pilot to production unit.

The process involved iteration from low-fidelity materials to begin defining a high-fidelity prototyping system. First, we used a web-enabled microcontroller, the Yellow Jacket 1.0 [9], and cardboard models to study interactions and enclosures. User scenarios and wireframes were developed to explore the miniBUG user experience. We used a visible synthesis [10] of walkthrough sketches to portray user actions and processes. Through the visible synthesis we were able to quickly see how actions moved from one scenario to the next. We next integrated the hardware into Bug module form and compatibility.

The miniBUG platform is being developed using a low fidelity process, paralleling the way that existing hardware microcontrollers are used for conceptual prototyping. MiniBUG is not only a product but also a production process. The key to miniBUG's interaction is simplicity in its interface, but not its functions. The interface is browser-based, including an online IDE, web services and API interfaces. The ability to manage code on the device itself, through a browser and without need for an IDE, is a powerful concept. It provides implicit

scalability and code sharing through cloud based systems, and direct migration to production systems.

MiniBUG will seek certifications that can extend to user products. MiniBUG products will leverage Bug Labs' supply chain and manufacturing relationships.

TANGIBLE USER INTERACTION OF MINIBUG

The miniBUG initiative has two main goals: to support an entire project life cycle from prototype to production, and to support the full learning curve of users who may vary from inventors to technicians. We have identified several critical moments through field research that miniBUG will address to achieve a successful user experience. Critical moments include: instant gratification style feedback, centralized services, web services, simple wireless protocols, and click-through prototype to pilot actions [11]. Instant gratification includes instant feedback, for example when the device powered on the web site will display sensor data to confirm that the device is awake. Instant gratification also includes supporting early user success with example code. The services we identified as centralized are a dashboard, an online IDE, and a graphical interface displaying the device state. This combination of features will guide people through the production process and will ensure feedback and success throughout iterative development.

The enclosure service will recommend options for the material and enclosure production methods. The options will span DIY 3-D printing such as Makerbot [12] to professional design services. The end user interface will be programmable and flexible. Because iterative process for designing objects is found to enhance creativity [13], we aim to develop a tool for faster iteration. MiniBUG products can evolve to become more innovative through this variety of open source and customizable attributes.

RELATED WORK

Related work extending to the 3-tier prototype, pilot, production model includes BUG from Bug Labs. BUGbase has been using the same business model to go from prototype to pilot to product. Bug Labs followed two case studies closely with this life cycle model — Accenture and DARPA [14]. These organizations followed the model of moving from prototype to pilot to production, iterating based on feedback, and receiving advisement and services for board redesign and enclosure modifications. Other modular hardware related work includes devices such as VoodooIO [15], and Blades & Tiles [16], and Gumstix [17], which include capabilities similar to miniBUG. Like miniBUG, these devices have pieces that attach as various modules. However unlike other prototyping TUIs, miniBUG has an added initiative to see users through the production process.

FUTURE WORK

Future work will move miniBUG from the prototyping stage to a production unit. The current form factor may be changed, and we may fork other forms of the miniBUG, allowing it to be encased in smaller forms and different shapes. Other future work will entail bridging miniBUG to other platforms to increase its functionality and improve the flexibility of the system.

CONCLUSION

While many hardware prototyping platforms exist, including other toolkits and microcontrollers, there is no one-stop solution to tie system-based prototyping together with piloting and production. MiniBUG is being developed to solve this problem in an inexpensive device, one that includes a process for bringing new products to market.

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