Jiradi:

Reflective Documentation to Support Learning and Skills Development

by

Marian Mwikali Muthui

B.Sc. Mechanical Engineering, University of Nairobi (2014)

Submitted to the Program in Media Arts and Sciences, School of Architecture and Planning, in partial fulfillment of the requirements for the degree of

Master of Science in Media Arts and Sciences

at the
Massachusetts Institute of Technology
May 2020

Author .....
Program in Media Arts and Sciences
May 19, 2020

Certified by .....
Mitchel Resnick
LEGO Papert Professor of Learning Research
Program in Media Arts and Sciences
Thesis Advisor

Accepted by .....
Tod Machover
Academic Head, Program in Media Arts and Sciences

Jiradi:

Reflective Documentation to Support Learning and Skills Development

by

Marian Mwikali Muthui

Submitted to the Program in Media Arts and Sciences, School of Architecture and Planning, on May 19, 2020 in partial fulfillment of the requirements for the degree of

Master of Science in Media Arts and Sciences

Abstract

In creative learning, reflection encourages learners to think critically about their experiences and helps to generate new ideas, insights, and outlooks. Maker practices recommend documentation, typically in the form of digital portfolios, as a method to encourage reflection. Documentation can serve two important roles: as a tool to support personal reflection about your learning experience and as a sharable record to showcase your skills development. Unfortunately, there are not currently any documentation tools that are optimized to support both personal reflection and skills development.

In this thesis, I introduce "**reflective documentation**" -- a term that I use to describe digital documentation tools that adopt a process-oriented approach to support both personal reflection and skills development. Based on this concept, I conducted design-based research to iteratively design Jiradi, a portfolio-based website where makers can easily create a portfolio to showcase skills and learning progression, express themselves creatively, and celebrate their maker journey.

This work has been greatly inspired by years of facilitating maker workshops in Kenya and prominently features insights from Africa. Through interviews with makers and observations of portfolios created using Jiradi, I examine the role of reflective documentation to support creative learning in maker practices, and also strategies to help makers better showcase skills through reflection. It's my hope that making can be perceived as a valid and acceptable pathway for youth, especially in Africa, to develop future skills and ultimately gain access to meaningful work.

Thesis Advisor:
Mitchel Resnick
LEGO Papert Professor of Learning Research
Program in Media Arts and Sciences, MIT Media Lab

Jiradi:

Reflective Documentation to Support Learning and Skills Development

by

Marian Mwikali Muthui

This thesis has been reviewed and approved by the following committee members

Jiradi:

Reflective Documentation to Support Learning and Skills Development

by

Marian Mwikali Muthui

Advisor

Mitchel Resnick
LEGO Papert Professor of Learning Research
Program in Media Arts and Sciences, MIT Media Lab

Jiradi:

Reflective Documentation to Support Learning and Skills Development

by

Marian Mwikali Muthui

Reader

Deb Roy
Professor of Media Arts & Sciences
MIT Media Lab

Jiradi:

Reflective Documentation to Support Learning and Skills Development

by

Marian Mwikali Muthui

Reader

Maria Yang
Professor of Mechanical Engineering
MIT

Table of Contents

List of Figures

List of Tables

"Those of us who have been privileged to receive education, skills, and experiences and even power must be role models for the next generation of leadership."

- Wangari Maathai

Acknowledgments

*"I can do all things through **Christ** who strengthens me."*
Philippians 4:13

Mitch Resnick + **Natalie Rusk**

Words cannot fully express how grateful I am to you both. I'm thankful for your unwavering thoughtfulness, kindness, and generosity. You make LLK feel like a home away from home, and for that I'm truly thankful.

Deb Roy + **Maria Yang**

To my readers, I appreciate your sound advice and feedback. Thank you for graciously spending time with me to help me think through my ideas.

LLK + **Scratch Team**

Thank you to my Lifelong Kindergarten family and the Scratch Team. To **Jaleesa Trapp**, **Sean Hickey**, **Carmelo Presicce**, **Shruti Dhariwal**, **Manuj Dhariwal**, **Yusuf Ahmad**, **Lily Gabaree**, **Kreg Hanning**, **Carolina Rodeghiero**, **Leo Burd**, **Ann Valente**, **Rupal Jain**, **Yumiko Murai**, **Abisola Okuk**, **Tina Quach**, and **Lena Abdalla**. I enjoy working and playing with each and every one of you. You are all one-of-a-kind, and your passion for supporting learners around the world inspires me.

Media Lab Community

Thank you for showing me that creativity has no bounds, and being a free space to openly explore ideas. A special thank you to **Arwa Mboya** and **Rubez Chong** for frequently welcoming me into their office to share ideas and stories.

Mekatilili

I would like to thank **Juliet Wanyiri,** my collaborator, for helping me throughout this journey. Your contribution has been invaluable. I would also like to show my appreciation to the previous 500+ Mekatilili participants, volunteers, and partners. Without your support, Jiradi would not have come to fruition.

Friends

I'm grateful to all my friends, both near and far. I appreciate the calls, texts, and memes to help keep me motivated and to also check up on me. Thank you!

Family

To my dad (**Charles**), mom (**Celestine**), and sisters (**Beth** and **Ruth**). Thank you for your love, guidance, and prayers. You have always encouraged me to follow my dreams and supported me at every step along the way.

A very special shoutout to **Ella** and **Leo**, for the endless joy they bring to my life.

Asante!

CHAPTER 1

Introduction

The Story of Mekatilili

In 2016, I co-founded the African maker program, Mekatilili, with my collaborator Juliet Wanyiri. Through the program, we facilitate hands-on, collaborative workshops on human-centered design, digital fabrication, physical computing, computer science, and professional development. Mekatilili adopts creative learning approaches and aims to empower African youth through technical and professional skills development. By early 2020, the program had reached over 500 makers from 18 - 25 years of age, with a primary focus on young women.

Figure 1: Images taken from Mekatilili workshops.

Mekatilili hosted its inaugural Mekatilili Fellowship Program (MFP) in January 2019, which was a gathering of African innovators to foster open-ended, playful, and peer-driven learning to promote

the development of appropriate and sustainable local technical solutions. It was aimed at building 21st Century Skills among fellows and to expose them to emerging technologies as part of professional development training to prepare them for the job market.

The learning opportunity was a 3-day workshop that was held in Nairobi, Kenya. It was in collaboration with the Technological Innovations for Inclusive Learning and Teaching (tiilt) Lab at Northwestern University and was supported by the Lifelong Kindergarten group at the MIT Media Lab and The Legatum Center for Development and Entrepreneurship at MIT. The 2019 fellowship program was focused on Human-Centered Design, the Internet of Things (IoT), and Artificial Intelligence (AI).

The thirty accepted fellows collaborated with students and faculty from Northwestern University and received mentorship from three Kenyan organizations (Twiga Foods Ltd, AB3D, and the Association for the Physically Disabled of Kenya - APDK). Through this program, the fellows and mentors co-designed specific solutions based on three tracks: Design for Accessibility, Agriculture, and Design for Manufacturing.

Figure 2: Image of the 2019 Mekatitili fellows, facilitators, and mentors.

Typically during Mekatilili workshops, participants present various physical artifacts that range in form, shape, and size. From artifacts constructed with crafting materials and bound together using glue and tape, to intricate electronic systems created using Arduinos, sensors, and various electronic components.

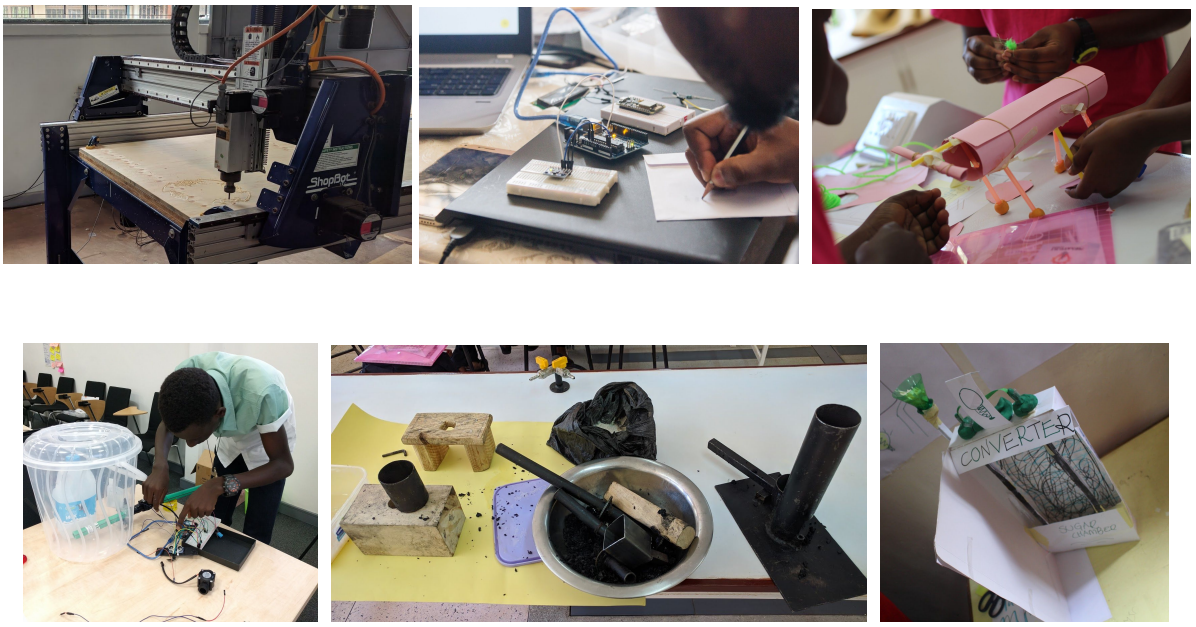


Figure 3: Physical artifacts created by participants during Mekatilili workshops.

However, a challenge that I encountered during workshops was how best to enable participants to capture, reflect on, and document their processes and activities that led to these unique creations. I explored various existing platforms that could be used to facilitate these actions, but there proved to be a limitation of technical resources that were optimized for our particular purpose.

Thinking About Thinking About Reflection

During the 2019 Mekatilili Fellowship Program (MFP), fellows were required to document and reflect daily on their experiences, work, and progress. Google Docs was used for open-ended reflection, which was completed on the final day of the workshop. In addition to that, Google Forms was used to provide a more structured analysis of their learning development and progression. Responses from the form were shared at the end of each day.

Responses captured using Google Docs revealed positive feedback about MFP. For example, Oboo Shitakha expressed that he appreciated the technical training as well as the opportunity to collaborate with peers:

> *It has been a fulfilling experience working with new hardware components during the prototyping sessions, which complements my passion for hardware programming and embedded systems engineering. It has been an exciting opportunity to work with other talented individuals in coming up with relevant solutions to specific challenges.*

With regards to Google Forms, the table below shows the list of survey questions, using a 5 point Likert scale:

Questions	Responses				
How would you rate your strengths in design?	1	2	3	4	5
How would you rate your strengths in AI?	1	2	3	4	5
How would you rate your strengths in IoT?	1	2	3	4	5
How would you rate your presentation skills?	1	2	3	4	5
How would you rate the current state of your portfolio?	1	2	3	4	5
How would you rate the current state of your resume?	1	2	3	4	5

Table 1: Mekatilili Fellowship Program survey questions.

From the first to the last day of the program, confidence in knowledge of concepts and technology increased from an average of 62% to 77%. These figures, calculated from the data collected through Google Forms, helped to provide practical results that confirmed perceived learning growth.

However, when I compared the structured responses (Google Form) with the open-ended reflections (Google Docs), I observed discrepancies between the two. Depending on the quality of information provided in the open-ended reflections, it was unclear if a fellow did indeed perceive learning growth. In fact, if I had based progress solely on the reflections, I would not have been able to gauge whether or not there was any improvement. I attributed this observation to the fact that the fellows did not receive proper guidance on how to best communicate their learning journey. From this, I inferred that the documentation tools that were used did not provide sufficient scaffolding to support makers to accurately articulate their progress. Hence, the open-ended reflections were not a true representation of the participants' skills competency.

The structured nature of Google Forms helped to concisely capture pertinent information; however, it strips agency from the respondents and fails to draft a personal narrative that can demonstrate storytelling, skills development, and communication skills. Conversely, tools like Google Docs allow complete autonomy over content and structure, but this can pose a challenge especially when considering it as an assessment tool.

In recent years, sites like Wix, Wordpress, Squarespace, Google Sites, Strikingly, and Weebly have gained popularity in schools and industry as tools to create technical portfolios that display a summary of a person's experiences. These portfolios are then used by educators and hiring managers

to assess certain skills and expertise. Ash (2000) found that in schools, they are used to "assess student performance through authentic work." In industry, Leahy & Filiatrault (2017) stated that not only do portfolios "allow potential employers to see the applicants' skills," but they also "allow applicants to better understand how to talk successfully about their abilities during an interview."

In order to prepare makers for various professional and learning opportunities, portfolio-based platforms that demonstrate the maker journey are necessary. They help to support personal reflection and to showcase their work to others. The Maker Education Initiative (2016) established the Open Portfolio Project to conduct research on portfolio use in maker-centered learning contexts in an effort to encourage portfolio creation in various spaces. In their work, they highlighted the importance of such tools by stating that:

> *Capturing and documenting one's work plays a strong role in enabling students to reflect on their own learning and development... They are a way for youth to showcase their abilities, whether they be academic knowledge, socio-emotional capacities, or technical skills...*

However, based on current documentation practices, portfolios may not adequately represent the skills of students or potential candidates. This is because unless the portfolio creator has external guidance on what precise content should be included, the result may not fully represent the learner's expertise. Furthermore, the design of documentation tools should be improved in order to provide sufficient scaffolding to users.

These findings reveal that there is a need for portfolio-based platforms that help makers to adopt a process-oriented approach to documentation. This means focusing on providing a descriptive account of project activities, motivations, insights, and challenges encountered during making. Thereby discouraging the emphasis of displaying only the end-product and other achievements (solution-oriented). By making this shift, such platforms can be used as assessment tools for schools and in industry. Additionally, these platforms would help to support personal reflection and skills development, and to showcase growth as learners and as makers.

CHAPTER 2

Background

Making in Africa

The history of making in Africa is an untold story of ingenuity and creativity. Traditionally, Africans utilized their environment to source materials like clay, plant fibers, stone, wood, and sand. Using these resources, they then manipulated them using techniques that were passed down from generation to generation. However, according to Mavhunga (2017), *"European colonialism from 1885 to the late twentieth century killed, disrupted, or delegitimized these sites of innovation and entrepreneurship by displacing Africans..."*

Modern day maker practices are reminiscent of African traditional art forms and fixer practices that are prevalent on the continent. Just like making today, Africans used their creative skills to solve problems that were faced in their communities (Maina, 1984), commonly utilizing art forms like pottery, weaving, and woodworking. Even in present time, informal sectors like the *jua kali* industry in Kenya (known for its non-conventional and scrappy ways of fabricating affordable and locally produced products), can be considered a microcosm of the maker movement.

A consequence of the rise of the maker revolution has been the proliferation of innovation spaces around the world, i.e.: makerspaces, hackerspaces, fablabs, and co-working spaces. In fact, as of July 2016, the number of active spaces in Africa increased more than 50% as compared to the previous year (Ecosystem Accelerator, 2016) - an indication of a sweeping interest in maker culture and the prioritization of 21st Century Skills on the continent. These spaces like FabLab Nairobi and Gearbox in Kenya, provide enthusiasts, experts, students, and professionals an enabling environment to develop innovative, long-term solutions that have successfully led to the creation of sustainable products and services. Consequently, this has provided new pathways to produce a more qualified workforce that has the potential to impact economic productivity across various sectors.

However, I believe that the maker spirit that embodies creativity, innovation, and curiosity can live beyond the walls of these physical spaces. Informal and non-profit organizations like Mekatilili, Akirachix, Global Minimum, Upeo Discovery, Pwani Teknowgalz, and KidsCompCamp in Kenya have developed innovative models and programs that increase access to maker skills among youth at the grassroots level -- thereby spreading the ideas and ethos of the modern day maker movement but adapting them to the African context.

Meaningful Making

Making is a way of self-expression. It's a way to interact with physical objects in new and meaningful ways that are influenced by interest and passion. Maker culture has democratized innovation and empowered young people to design and develop disruptive products and services. In education, it supports constructionism through learning by making (Papert, 2000) and it further contributes to peer-to-peer learning through the utilization of open-source technologies and systems. This has encouraged young makers in Africa to seek meaningful work opportunities based on doing what they love: making.

Africa is predominantly made up of young people. Youth, aged 15 - 24, on the continent constitute nearly 20% of the population and this figure is expected to double by the year 2030 (African Development Bank [ADB], 2016). The advent of the maker movement has provided legitimate pathways in which African youth can utilize traditional art forms and fixer practices to gain new skills, seek support through collaboration, and discover opportunities. Hence, through the participation of youth in maker culture, this demographic dividend can provide the critical mass required to develop industry on the continent driven by science, technology, and innovation in preparation for the future of work.

Creative Reflection

Reflection is a concept that has been extensively explored by educational researchers and psychologists. In his book *How We Think*, Dewey (1933) stated that *"active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends, constitutes reflective thought."*

Reflection was also supported by Schön (1983), who was interested in understanding the role of reflection in professional settings. He found that professionals reflect while engaged in an activity (reflection-in-action) and after the activity (reflection-on-action). Hence when a person chooses to practice reflection is based more on personal preference. Reflection-in-action can disrupt flow; however insights can be formulated quickly. On the other hand, reflection-on-action supports a holistic perspective; however, specific elements of activities may be forgotten or overlooked.

In addition to that, Kolb (1984) proposed the experiential learning theory which highlights reflection in the experiential learning cycle (Figure 4) that depicts the duality and significance of concrete and abstract learning.

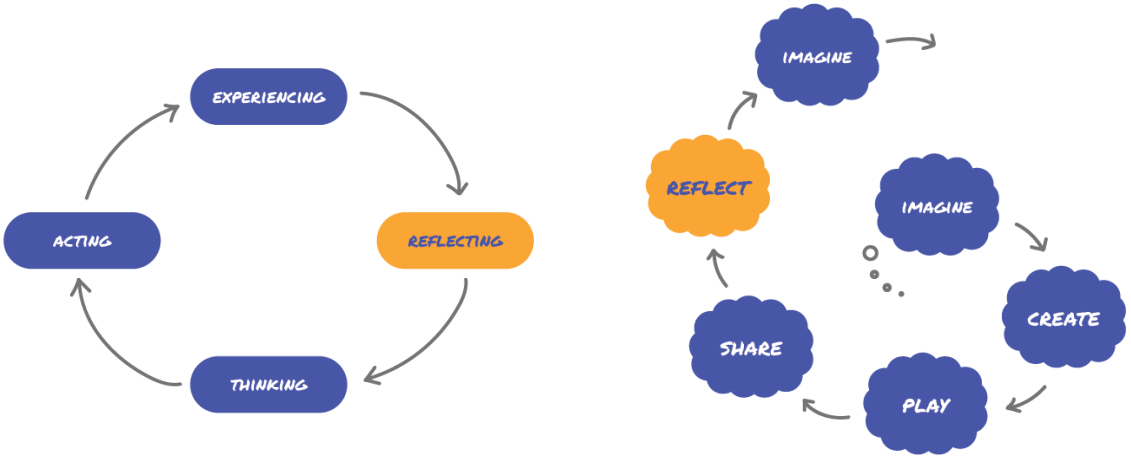


Figure 4: From left to right: The Experiential Learning Cycle, The Creative Learning Spiral.

Kolb's description of learning as *"the process whereby knowledge is created through the transformation of experience,"* emphasizes the appreciation of a process-oriented approach rather than a solution-oriented approach. Despite this, it was observed by Resnick (2017) that:

> *In recent years, schools have adopted more "hands-on" design activities, but the focus is usually on the creation of an artifact rather than critical reflection on the ideas that guided the design, or strategies for refining and improving the design, or connections to underlying scientific concepts and related real-world phenomena.*

Resnick also highlighted the importance of reflection in learning through The Creative Learning Spiral (Resnick, 2007) (Figure 4), which models an approach to learning that helps develop 21st Century Skills among learners.

Reflective Documentation

A concrete method that supports reflection is documentation. As Dalsgaard and Halskov (2012) stated:

> *Documentation may serve the double role of supporting reflection, thereby serving as a source of insight, and providing evidence that supports the insight gained. Given the inherent complexities of design, this process of capturing and documenting design projects can be daunting, especially since there are few resources and tools developed for this particular purpose.*

As much as documentation supports reflection, not all pieces of documentation are reflective. In order to showcase appropriate maker skills, documentation tools that support creative learning and reflection at various stages of the maker journey are necessary. However, current portfolio-based websites are not optimized to support the scrappy nature and dynamism of making. In relation to software requirements, there is still a need to improve documentation resources (Maker Education Initiative, n.d.) as there are no available platforms that allow for various levels of sharing and access for makers and learners (Maker Education Initiative, 2016).

To mitigate this challenge, in this thesis, I investigated reflective documentation, which I describe as digital documentation tools that adopt a process-oriented approach to support personal reflection and skills development. Through this work, I designed and developed Jiradi - a portfolio-based website for makers that supports reflective documentation.

The outcomes of using reflective documentation tools are:

- Promote creative learning and constructionism.
- Foster serendipitous learning.
- Improve readability of maker projects.
- Improve assessment of learning progress.

CHAPTER 3

Jiradi

Jiradi is a reflective documentation tool for makers. It's a portfolio-based website that allows users to easily curate a portfolio to showcase work and keep track of their maker journey.

Jiradi has been designed to provide the necessary scaffolding to support a process-oriented approach. The website aims to help makers seek satisfaction in the process of creating and expressing themselves through their work rather than feel daunted by the goal of presenting finished or polished projects.

Think about your favorite book: it's divided into chapters and each chapter can be further divided into parts or sections. Each chapter marks a progression in the narrative. Just like a book, projects in Jiradi are divided into project phases and further into project steps that reveal new insights and reflections into the project. The design and architecture of Jiradi aims to capture these experiences of storytelling and adopt them in making.

The key features of Jiradi are:

- Curate a personal and secure online portfolio of creative projects.
- Create a profile that includes information about the maker, highlights experiences, and helps to keep track of skills development.
- Save completed projects or works-in-progress, and retrieve them at any time.
- Simplify project documentation through a custom step-by-step format.
- Upload and quickly edit images that support projects.
- Learn best practices to improve documentation and spark reflection.
- Selective sharing of projects to protect personal information and to support authenticity and credibility of work.

Information Architecture

Signup Page & Login Page

To begin creating a portfolio, makers are first required to register using their first name, last name, and email address. They also need to create a password. A message will then be sent to the email address for verification. Alternatively, there is also an option to sign up directly with Google. Once the registration process in complete, users can then proceed to access the website.

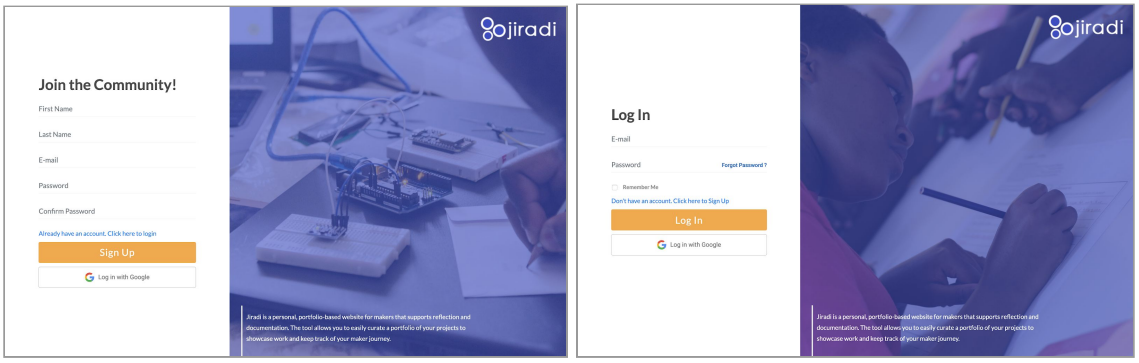


Figure 5: From left to right: Screenshot of Signup page and Login page.

Profile Page

Once signed in, makers may complete their profile page to include general information about themselves, skills, and contact information.

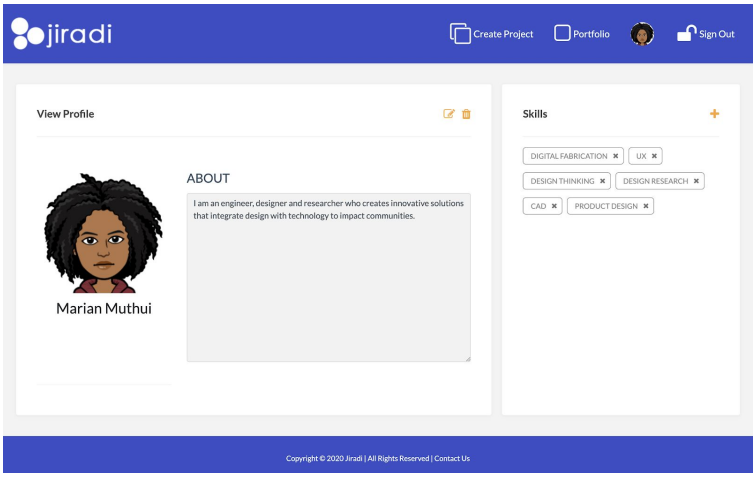


Figure 6: Screenshot of Profile Page.

Homepage/Portfolio Page

The homepage consists of the portfolio section which displays all projects by the maker: both completed and works-in-progress. This section also includes a sample project to help users easily get started.

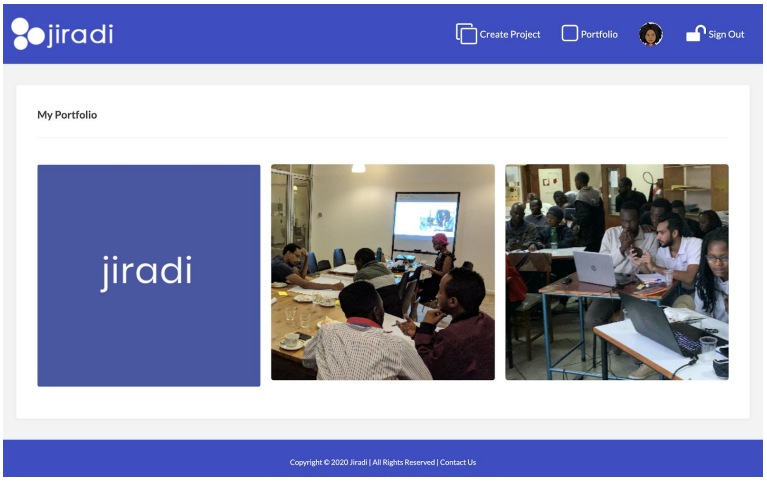


Figure 7: Screenshot of Portfolio Page.

In Jiradi, a portfolio is defined as a collection of projects. On the platform, a unique user may have many projects but only one portfolio.

Create Project Page

On clicking the 'Create Project' button on the portfolio page, the maker is redirected to a page that allows them to provide background information on the project that they will create. This page contains sections to include the project name, project description, materials used, and date created.

In this section, makers are encouraged to predetermine their design process that will organize their projects into various phases. A phase is defined as the process that makers follow in order to create something. Examples of phases could include: Design, Fabrication, Research, Implementation, Testing, Assembly, Prototyping, etc. The phases are all user defined and they may add as many or as few as they like. If the maker chooses, they may change the phases at any time. This helps to cater to learners who consider themselves either planners or tinkerers.

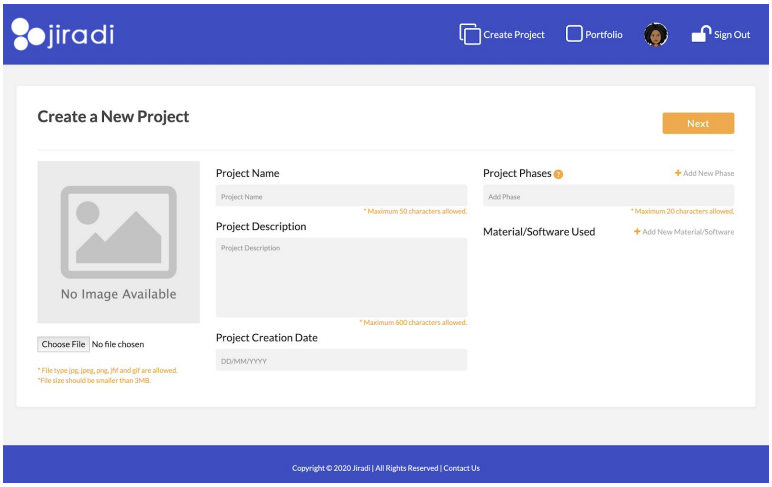


Figure 8: Screenshot of Create Project Page.

Build Project Page

In this section of the website, makers begin to describe their project activities by uploading images and including brief, descriptive text.

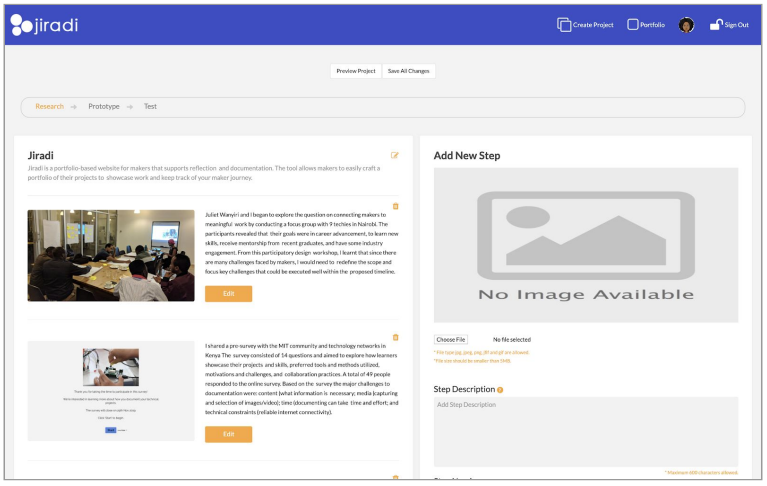


Figure 9: Screenshot of Build Project Page.

In Jiradi, a project phase is divided into project steps and in each step, a user uploads a single image and inputs text. The number of characters in each textbox is limited to 600, to keep descriptions concise. The number of steps in a phase is unlimited.

In the steps, makers use the text boxes to briefly explain what they did, how they did it, any challenges encountered, or what they learnt during the process. For example, if they're working on an Arduino project, one step could be discussing selecting appropriate sensors, while another step may be about connecting all components to the Arduino. Makers can then save projects at any point in a phase or step, whether they are complete or works-in-progress.

View Project Page

This page includes a horizontal slideshow gallery with images and text that dynamically change as you click through the images. Selecting any image in the gallery will reveal a lightbox that will present an enlarged version of the selected image.

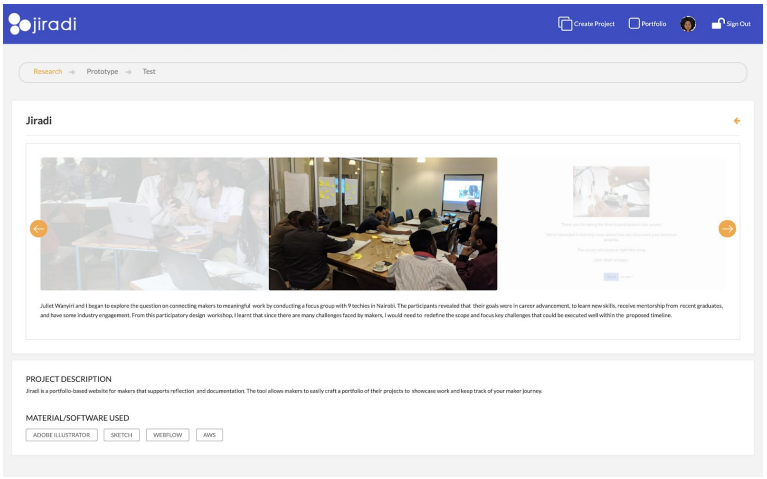


Figure 10: Screenshot of Build Project Page.

Most portfolio-based websites adopt a linear layout that displays large images without any caption or text to describe the artifact. In this case, users typically need to vertically scroll through the page to view the complete project. Jiradi attempts to eliminate the fatigue of this process and presents makers' work in a format that emulates a visual narrative, thus improving the user's experience.

CHAPTER 4

Inspiration

Build in Progress (BiP)

Build in Progress was a design documentation tool that was created by Tiffany Tseng and launched in May 2013. Tseng's focus of research was in design documentation and was further interested in investigating the role that *"make-through documentation"* plays in enabling reflective practice (Tseng, 2016).

BiP was a portfolio-based website that allowed users to create personal accounts on the platform to document projects. The tool further allowed makers to engage with each other through the online community by receiving feedback on projects and enabling users to follow each other. It also allowed users to build on other projects through remixing so as to help makers learn from each other's processes. Specific privacy settings allowed for users to either share projects publicly, make private, or mark as unlisted.

BiP was designed to encourage users to be transparent about their design process (Tseng, 2016). On the website and its supporting mobile application, a single project was structured hierarchically using a feature called a Process Map to showcase the various steps taken by the maker in their design process. With BiP, projects were shared through branching, which highlighted different pathways used during making. Projects could further be classified into categories, eg.: electronics, cooking, clothing, mechanical, etc., to improve searchability on the site.

As of September 2016, the platform Build in Progress was archived and new projects can no longer be created due to constraints in maintaining the website.

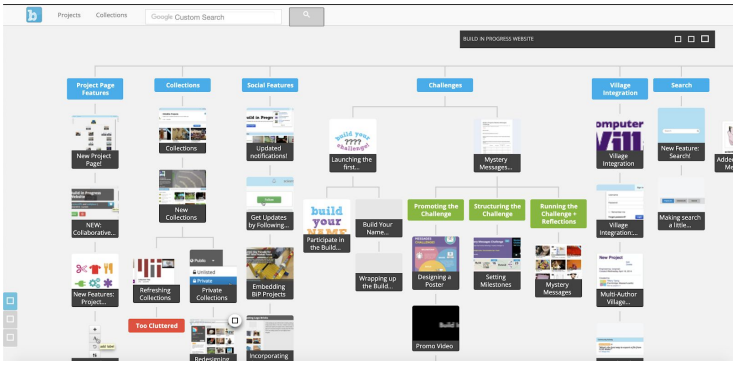


Figure 11: Screenshot of Build in Progress.

Jiradi draws inspiration from Tseng's research and work. Similar to Build in Progress, Jiradi attempts to rethink the way makers document their projects and emphasizes a process-oriented approach. Both Jiradi and BiP are portfolio-based websites that consider the design of the platform as an important component to encourage reflection among makers. While BiP allows for projects to be publicly shared and supports collaboration among makers, Jiradi emphasizes personal reflection and selective sharing of projects to highlight makers' skills development.

Behance

Behance is a website for creatives like photographers, illustrators, graphic designers, product designers, and animators to showcase their work. The website brands itself as a social media platform, and in 2017 the website hit over 10 million members (Behance, 2017).

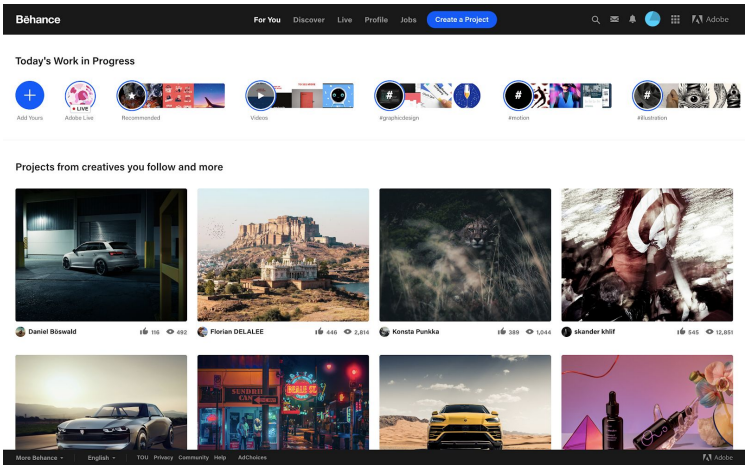


Figure 12: Screenshot of Behance Homepage.

Using the website, registered users can create portfolios and engage with other creatives by following each other, giving appreciation, and commenting on projects. Each project profile displays

the number of designs created by the user and the number of project views. When creating a project, content is arranged in a linear layout, and media and text can easily be rearranged within the given structure.

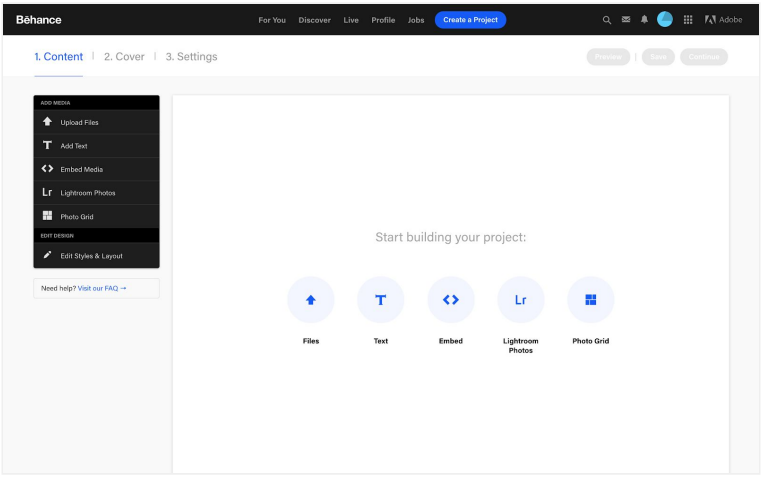


Figure 13: Screenshot of Behance Project Editor.

Community guidelines help to manage issues like ownership and privacy. Through a subscription to Adobe Creative Cloud, users can have access to Adobe Portfolio, which is Behance's "Do it yourself" (DIY) website builder tool.

A similarity between Jiradi and Behance is that they are both portfolio-based websites for creatives. However, Behance is more solution-oriented as members tend to publish quality, completed projects and the website is geared toward professionals. The aim of Jiradi is to highlight a maker's learning process, and is designed to showcase all types of projects with varying levels of fidelity.

Instructables

Similar to recipes in a cookbook, Instructables enables makers to break down their projects into step-by-step instructions to allow for collaboration, learning, and knowledge transfer. The website is targeted towards students, teachers, parents, hobbyists, and professionals.

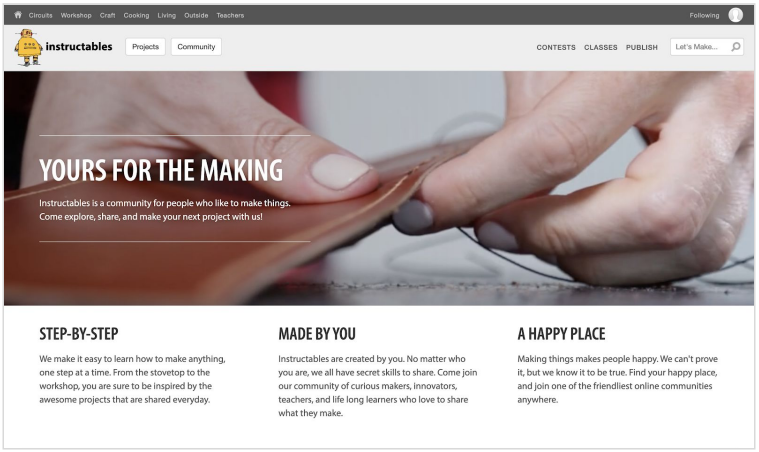


Figure 14: Screenshot of Instructables Homepage.

To create a new instructable, users must be registered on the website. Projects are broken down into a chronological list of steps. Uploaded projects are mainly focused on STEAM (Science, Technology, Engineering, Arts, Mathematics), and are grouped into several categories. The website also has various engagement features (views, comments and favorites), which allow users to connect with each other. Each project also includes a feature that allows users to download a PDF version of the particular Instructable.

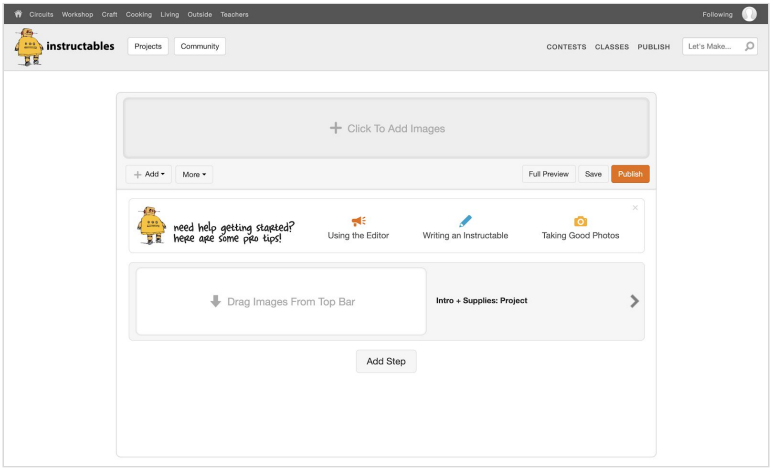


Figure 15: Screenshot of Instructables Project Editor.

Similar to Jiradi, Instructables is targeted towards makers, but is focused more on *"creative appropriation"*, which refers to remixing a person's creative work (Jenkins, 1992). This website is also heavily driven by the active online community that supports and guides each member to learn and gain skills.

MAKE

MAKE is an online platform for makers that is focused on DIY projects. The MAKE platform supports documentation in two ways: step-by-step, tutorial guides for makers (Make Share) and a portfolio section to showcase projects (Make: Magazine).

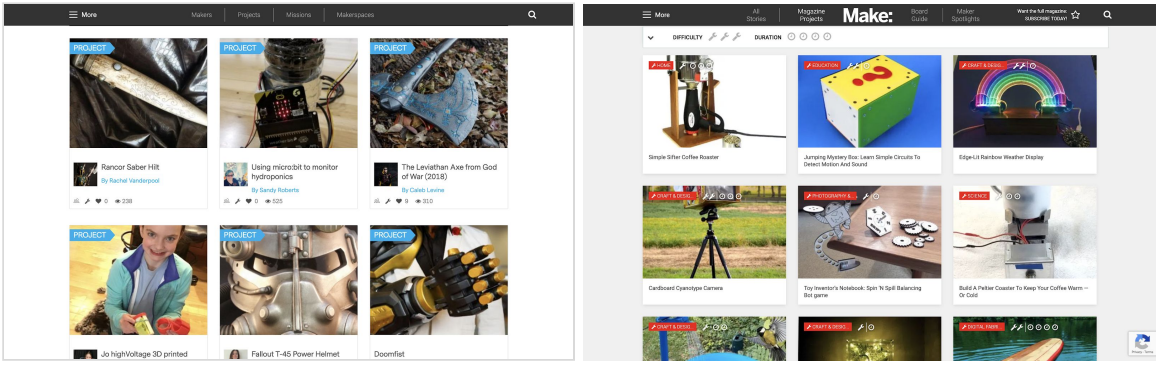


Figure 16: From left to right: Screenshot of MAKE Share Homepage, MAKE Projects Homepage.

Make Share maintains a list of makers and a portfolio of their work. As of February 2020, the section has over 12,000 registered makers. On the other hand, Make Magazine projects are categorized into craft and design, digital fabrication, science, drone and vehicles, home, technology, and workshop. When documenting work, users must define tools and parts used, and also determine price, difficulty, and time required to complete the project.

Unlike Jiradi, both sections of MAKE let users engage on projects through likes and comments. Furthermore, the layouts adopt a blog-like format, which allows for flexibility of content but lacks any scaffolding for makers.

CHAPTER 5

Design Process

This thesis considered the following research questions:

How might reflective documentation support creative learning in maker practices?

How might makers better document projects for personal reflection and to showcase skills?

To begin the investigation into these research questions, it was essential to anchor them on tried and tested design methodologies that would ensure that a suitable and appropriate solution was developed. The main methodologies that I utilized were:

- Human-Centered Design (HCD)
- User Experience Design

Human-Centered Design

Human-Centered Design (HCD) employs a humanistic approach to problem solving by emphasizing the needs of the user. It is modelled by a cyclical and iterative process that consists of various steps that are aimed to improve overall design and functionality of products based on user feedback.

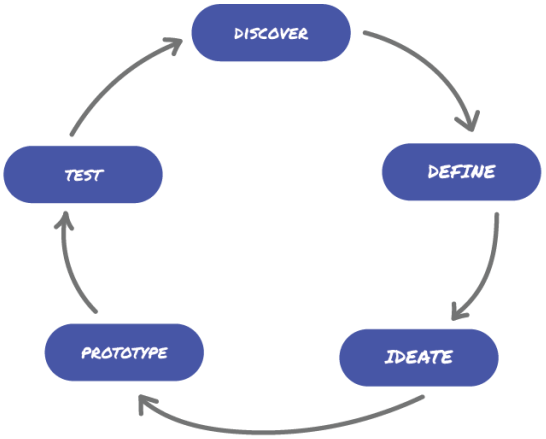


Figure 17: Human-Centered Design Model.

The next three chapters detail the steps in the HCD model and describe the in-depth activities that went into the research, development, and implementation of Jiradi.

User Experience Design

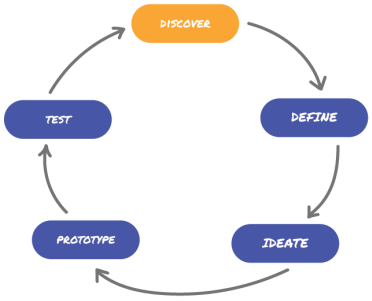
User experience (UX) design methodologies are certain activities performed by designers to improve users' experience of digital products. These activities focus on how users feel when using a digital tool that usually involves a form of human-computer interaction (HCI).

Most of the user experience design activities that I used were integrated into the Discover, Prototype, and Testing phases of the human-centered design process. These activities included:

- Surveys
- Interviews
- Personas
- Journey Mapping
- User Flows
- Wireframes
- Mockups
- Concept Testing
- Usability Tests

CHAPTER 6

Discover



Exploration into reflective documentation began by conducting various activities in order to understand the needs of makers and gain insights into problems, challenges, and pain points around documentation of projects using currently available portfolio-based websites.

Survey

I shared a survey with the MIT community via mailing lists and also with technology networks in Kenya through WhatsApp groups, LinkedIn, and Facebook. The survey consisted of 14 questions and aimed to explore how learners showcase their projects and skills, preferred tools and methods utilized, motivations and challenges, and collaboration practices. The list of survey questions is included in Appendix A.

Demographic Information

A total of 49 people responded to the online survey. The average age of the respondents was 25 - 34, with the majority (47%) being students. With regards to geographic location, 45% of the participants were located in Kenya, while 51% were located in the United States.

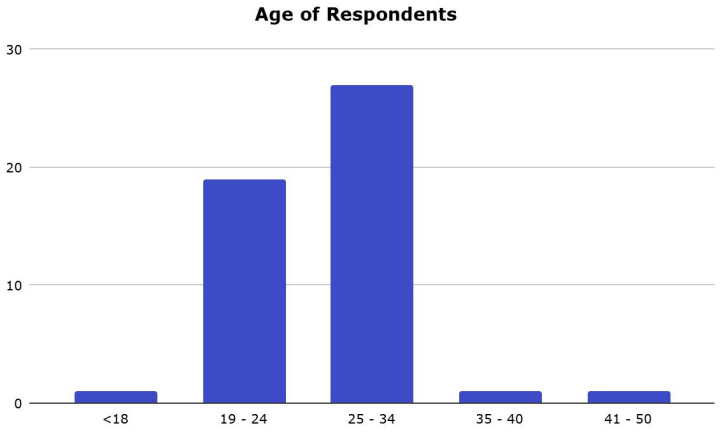


Figure 18: Age of participants in survey.

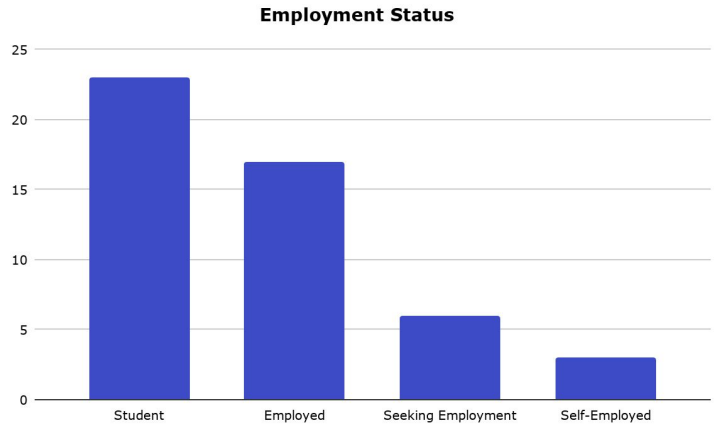


Figure 19: Employment status of participants in survey.

Documentation Practices

When questioned whether or not they had portfolios, the majority (82%) of participants answered in the affirmative, with 41% revealing that they had more than 10 projects documented in their portfolios.

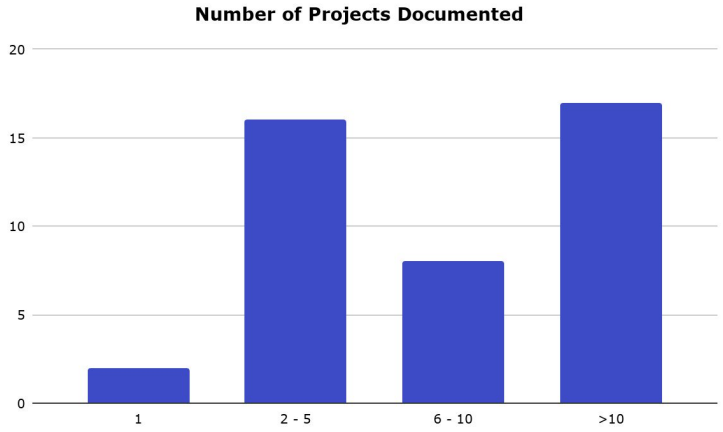


Figure 20: Number of projects documented of participants in the survey.

To determine the factors that makers take into consideration when selecting a documentation tool, the occurrence of certain words and phrases from the responses was tallied and are summarized below:

Word/ Phrase	Definition	Occurrence
Ease of Use	Simplicity of getting started.	37%
Design	Website aesthetics, layout and structure.	14%
Collaboration	Ability to connect with people on the website and build community.	14%
Reliability	Ability to receive updates, data protection, fix bugs, etc.	8%
Customization	Ability to modify templates and website design.	8%
Reputation	Number of active users.	6%
Integration	Ability to integrate the website with other platforms.	6%
Cost	How much membership costs.	5%
Media Support	Types of files which the website can support.	2%

Table 2: Factors to consider when selecting a documentation tool and their occurrence in the survey.

Documentation Methodology

In the survey, participants were asked to describe how they document projects. When determining this, the responses revealed certain themes that makers consider. These are:

Project Structure

Participants described how they generally structure projects before they begin documenting work. Usually this entails including certain relevant sections, as one maker pointed out that they organize their projects to include a brief overview, materials used, and objectives achieved.

Moreover, a respondent emphasized their preference of a process-oriented approach and their desire to incorporate storytelling: *"I like to show my process. I document the problems, my observations, my ideation process, and my prototypes. I like to try to tell a visual story."* Another maker described a similar technique: *"I gather materials together that illustrate the project while being mindful of participants and decide how I want the viewer to experience the content then I design the page."*

Media Selection

The responses also revealed that makers generally use various media to to include in their portfolios. They take pictures, videos, generate PDFs, and GIFs, as they develop their projects and then upload them in their portfolios.

Images and video are the popular choice of media to use: *"I take lots of photos and video, put them together into a loose narrative with minimal text that covers what it is and why it's important first..."* For others, remembering to take pictures during documentation is a challenge: *"I never take pictures but I need to. Usually they're taken in the moments of prototyping, rendering, and final product... And if I do, finding those photos is hard."*

Progress Made

Insights gathered from the survey disclose that makers differ in when they begin their documentation, either during the project: *"I have a wiki page and update it as I progress through a project,"* or when the project is complete: *"For me, it is retrospective documentation after everything is done."*

Documentation Motivation

A variety of intrinsic and extrinsic factors were brought out by participants when asked what their motivations were to document and share projects online. I categorized the responses as follows:

Professional Purposes

A subset of the respondents mentioned being motivated by professional reasons. Some of these reasons pertained to seeking employment or for academic purposes: *"My portfolio helps during my job search,"* and also *"mainly to have something to show for applications and residencies."*

Knowledge Sharing

Following the responses from the survey, many were motivated to document their work in order to inspire other makers: *"My goal is to give people some idea of my interests and skills, and perhaps inspire others."* Another participant mentioned supporting others: *"I hope to help and guide people on how to go about similar projects."*

Creative appropriation was another key motivator: *"I want to be able to share my work, and allow for it to be reused freely,"* while others brought up collaboration by connecting with others and receiving feedback on work.

Personal Reflection

For some participants, they perceived documentation as a personal experience without the expectation of external viewership. When asked why they document, a participant responded: *"For no one's interest, but I like doing it to have a record."* Others noted their use of documentation as a learning tool: *"I'm just trying to get into the habit of building a body of work so I can see my trajectory over time."*

Documentation Challenges

From the 19% that indicated that they do not have a portfolio, a variety of reasons were recorded. In summary, the biggest challenges to documentation are as follows:

Content

A plurality (49%) of the responses referred to content being the biggest challenge for makers. They were unsure of how to get started: *"I have plans to build one, I just don't have enough information on how to go about it, and I never really set the time to do proper research on it,"* while another said that it was a challenge *"finding out how to best structure the documentation so others can find it easy to follow."*

Moreover, others mentioned that it was unclear how best to articulate work in a portfolio caused by trying to *"figure out what information other people want to know and what I may not*

realize they need to know." Another shared a similar challenge of *"being able to make the public understand the project and see the relevance of documenting."*

Media

20% of the responses discussed challenges based on capturing, selecting, and uploading media in a portfolio. A participant mentioned they had issues *"getting nice pictures,"* while another had problems *"taking any photos during the various stages."*

Time & Effort

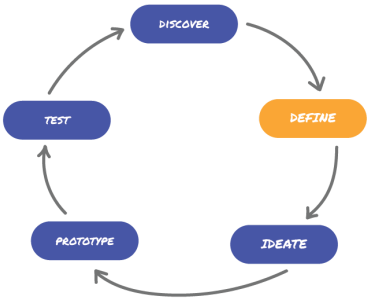
16% of the responses claimed that creating a portfolio was somewhat tedious. The amount of time and effort needed to document work was a concern for participants: *"I often don't document my projects, because I do not like the process of documentation."* A maker related it to issues around *"cost, time and effort with no clear idea of what the outcome might be,"* while another added that it was a challenge *"mustering effort to document."*

Technical Constraints

11% referred to technical issues as a challenge. The respondents brought up poor internet connectivity and lack of internet access as the primary technological concerns: *"I can't do much work offline because most of my documentation techniques require the Internet and I live in a country where WiFi is not ubiquitous. The areas where it's available, can be really slow."*

CHAPTER 7

Define



From the data collected from the survey, I inferred valuable insights into how makers document their work, their motivations, and challenges.

Furthermore, from the survey, I was able to summarize key documentation considerations when using portfolio-based websites in relation to practices, methodology, motivation, and challenges. This information is tabulated below:

Documentation Considerations

Practices	Methodology	Motivation	Challenges
Ease of Use	Project Structure	Professional Purposes	Content
Design	Media Selection	Knowledge Sharing	Media
Collaboration	Progress Made	Personal Reflection	Time & Effort
			Technical Constraints

Table 3: Summary of documentation considerations.

User Selection

It's unlikely to develop a solution that exactly meets all the needs of all makers. This corresponds to the paradox of specificity, which theorizes that targeting a specific audience can actually cater to the needs of a larger audience (Cooper, 2004). Following this, I designed Jiradi for a specific user group.

The user group selected consists of youth, aged 16 - 25 based in Kenya, and with an interest in making.

To concretize this information, I came up with the following persona of an ideal user of Jiradi.

 **Name** Aisha Juma	**Occupation**	Student at the University of Nairobi pursuing an undergraduate degree in Electrical Engineering.
	Age	19
	Interests	Designing and developing innovative products; making
	Goals	- To improve her maker skills - To find meaningful work after graduating - To connect with other makers.
	Challenges	- Unable to find opportunities. - Unaware of methods to showcase skills.

Table 4: Jiradi persona.

Design Principles

To derive design principles, I correlated the research questions that were posed in Chapter 5, with the documentation considerations in Table 3. These design principles informed the overall design and development of Jiradi.

Low Floors, High Ceilings

Low floors, high ceilings was a design principle proposed by Seymour Papert when developing the Logo programming language (Papert, 1980). He described this principle to mean that the tool should be designed to allow users to easily get started (low floors) but also support projects and advanced concepts (high ceilings).

It was important for me to incorporate this principle into the design of Jiradi because the primary users have varying skills levels and experience creating portfolios. Some are experienced makers with more than five projects documented, while others do not even have a portfolio, and are uncertain about how to get started.

To ensure that I meet the needs of these different makers, Jiradi has been designed to help users get started very easily and to be intuitive. The user interface (UI) maintains a minimalist aesthetic that is easily navigable. The website includes only necessary actions, elements, and features to avoid cognitive overload.

Moreover, in line with 'high ceilings', Jiradi supports makers' skills development. For example, the website is suitable for a maker who is just getting started with DIY/hobbyist projects, and is still appropriate for them if they would want to document complex projects that require advanced skills.

Jiradi aims to achieve a balance between agency and structure (Brennan, 2012) to appeal to makers who prefer tools that support customization, but also to those who need guidance to assist them to get started. Websites like Wix, Weebly, Squarespace, and Wordpress are very flexible and allow extensive customization, but do not incorporate scaffolding to support users to manage and organize content. Conversely, websites like Behance, Dribble, and Github do have some of these elements but are designed for specific content and not physical artifacts or prototypes.

More Process, Less Product

Jiradi supports a process-oriented approach through embedding scaffolding techniques to ensure that makers provide insights into the steps undertaken to develop solutions. These steps detail the project overview, what they did, what they learnt, challenges, and findings. This helps makers to learn through making and to continuously seek opportunities to improve skills.

An example of these scaffolding techniques include prompting makers to determine their project phases before creating a project. By doing so, makers will have generated high-level tasks that they can use as guidelines to structure their projects. These plans are adaptable, therefore users are allowed to edit phases at any point to cater to learners who are planners, tinkerers, or a combination of both. Moreover, phases are broken down into steps to let makers work at a more granular level.

All these features and elements have been included in the website architecture to support a creative learning approach. Ultimately, makers will possess a repository of past projects that promotes reflection and showcases their skills and learning progression.

Selective Sharing

Based on the findings from the survey, a key concern was on data protection and intellectual property, ie.: Firstly, how to ensure that projects shared on portfolio-based websites are secure? Secondly, how to validate the authenticity of project ownership on these platforms?

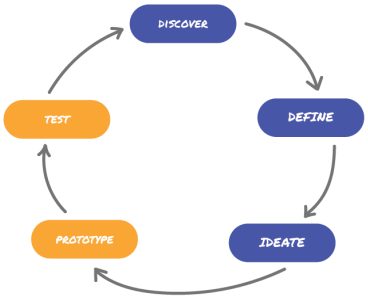
This was emphasized when discussing the limitations of Github. One participant said, *"Anyone can download your repository and claim your work to be theirs."* Furthermore, another participant had a similar issue and was hesitant to create a portfolio because: *"The work that I do is confidential."* Taking these concerns into consideration, one of the major design decisions that I made was to enable selective sharing of profiles and portfolios. This means that there is no direct feature that can allow makers to share their projects publicly.

Inasmuch as many respondents attributed community and collaboration as a desirable feature in portfolio-based websites, the decision was also made to encourage personal reflection and avoid users from feeling intimidated or discouraged by making comparisons of their work with others on the website. Furthermore, research from Kenya found that Kenyan innovators are concerned about intellectual property. As Alev Coban (2019) found when researching into makerspaces in Kenya: *"... makers feared the theft of their ideas during hackathons and in the shared use of a makerspace..."*.

Additional research also exposes some risks to sharing work publicly online. In research about the Scratch visual programming language and online community, Brennan, Resnick, and Monroy-Hernández (2010) made the following observation during a workshop with students and members of the Scratch online community: *"a workshop participant looked at projects in the online community and felt intimidated by what he perceived to be unattainably high-quality work, and a current online community member was discouraged by an early experience with negative feedback."* Furthermore, it has been found that girls tend to share less of their early work than boys and because of that, they tend to stop creating new projects after some time (Gan, Hill, & Dasgupta, 2018).

CHAPTER 8

Prototype & Test



The 'Ideate' portion of the human-centered design process has been discussed in Chapter 3, therefore, I will move next to the prototype and test stages. In this section, I will discuss the different iterations of Jiradi, which were informed by various in-person and virtual activities that I facilitated to get feedback from makers on ways in which to improve the platform.

An agile methodology was adopted at this stage whereby small incremental changes were made to the prototypes and tested soon after, rather than develop the complete tool and to only test it at the end of the development cycle. This was done in order to have more opportunities for makers to engage with the website for feedback and to detect bugs at earlier stages.

In this section, I will review in detail three design iterations that will discuss the evolution of the problem statement and proposed solution, and the subsequent changes that were made to them over time as the design principles for this project became apparent. The iterations showcase a convergent thinking approach to arrive at a suitable solution beginning with very early-stage explorations and proof of concepts, to the final Jiradi website.

First Iteration

Problem Statement: How might creative professionals better showcase their skills, and also enable employers to easily identify new talent?

In early 2019, I applied for the opportunity to participate in an IDEO CoLab design sprint (in Cambridge, MA), which was in collaboration with MIT Media Lab. The purpose of the workshop was

to turn Media Lab research ideas into tangible opportunities by matching Media Lab students with experts and members of IDEO CoLab, and a few technology and corporate organizations. Additionally, to collaborate with designers and industry experts to test the research ideas and build prototypes.

I submitted the idea to explore how to help creative professionals better showcase their skills and to find meaningful work and fortunately, I was accepted to participate in the design sprint. The initial idea was focused on developing a portfolio-based website that enables makers to create and share their projects, collaborate with peers, and match them with work that is best suited for their skills. This was in an attempt to also solve for limited visibility of skilled and talented makers to potential employers.

As part of the process, I was encouraged to form a team to collaborate with. IDEO CoLab pre-selected a team for me which consisted of members of the IDEO CoLab team and some other company representatives, plus I had the option to invite anyone who I felt would be vital to the process. Therefore, my team comprised of Juliet Wanyiri (MIT IDM), Kseniya Galper (UX Director, Fidelity Labs/FCAT), Ian Wall (Team Lead HR Research, Steelcase), and Jacob Waites (Visual & Interaction Design Lead, IDEO CoLab).

During the week-long session, we conducted interviews with three makers - two based in Kenya and the other in the US. We also got the chance to interview a hiring manager, who is based in the US, to understand their hiring practices and to learn more about how they evaluate portfolios.

By the end of the sprint, we had successfully developed and demonstrated a proof of concept in which portfolios were automatically generated on the platform by simply uploading text and images to a maker's Dropbox folder that was integrated into the website using the Dropbox API. The portfolios that were generated simply populated text and images on the website in a linear layout. It was also demonstrated how a potential employer seeking talent could identify suitable candidates by searching for makers with specific skills using predefined tags.

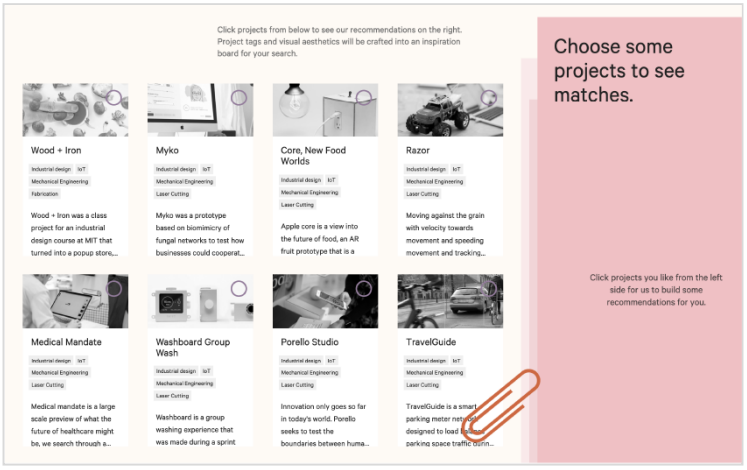


Figure 21: Screenshot of the platform created during IDEO CoLab design sprint that helps employers easily identify creative professionals. Each panel represents a maker project.

User feedback of the proof of concept developed during the design sprint showed that makers liked the ease of creating portfolios; however, they would have preferred the ability to customize their own rather than having it auto-generated. Additional feedback from employers and hiring managers showed that they appreciated the skills-matching feature to ease candidate selection.

The IDEO CoLab design sprint, exposed two main aspects about the idea that needed to be improved. Firstly, with regards to documentation, makers require scaffolding features to help them get started, but also the flexibility to personalize it. Secondly, as much as skills matching was an important feature to integrate in the website, it would be beyond the scope of this thesis and would be considered in future work. Therefore going forward with the next iteration, I needed to start from the drawing board - rethinking all technical components developed, but utilizing the insights gained from the design sprint.

Second Iteration

Problem Statement: How might a portfolio-based platform for makers be designed that supports reflective documentation and peer collaboration?

The first iteration used a basic blog style layout, which due to the pervasiveness of texts and images, can lead to limited readability of projects. This is because with such layouts, people tend to spend more time reading content on the top of the page than what is on the bottom (Fessenden, 2018). This is commonly referred to as scrolling fatigue and can lead to less engagement of makers on the platform.

To break this scrolling cycle, I considered a horizontal layout rather than a linear one to display projects. This layout would take the form of a slideshow gallery with images and text that would dynamically change as makers move from one project step to the next. Furthermore, the second iteration saw the introduction of the 'Create Project' page.

To begin prototyping these new ideas, I began by designing wireframes using Adobe Illustrator and mockups using Webflow.

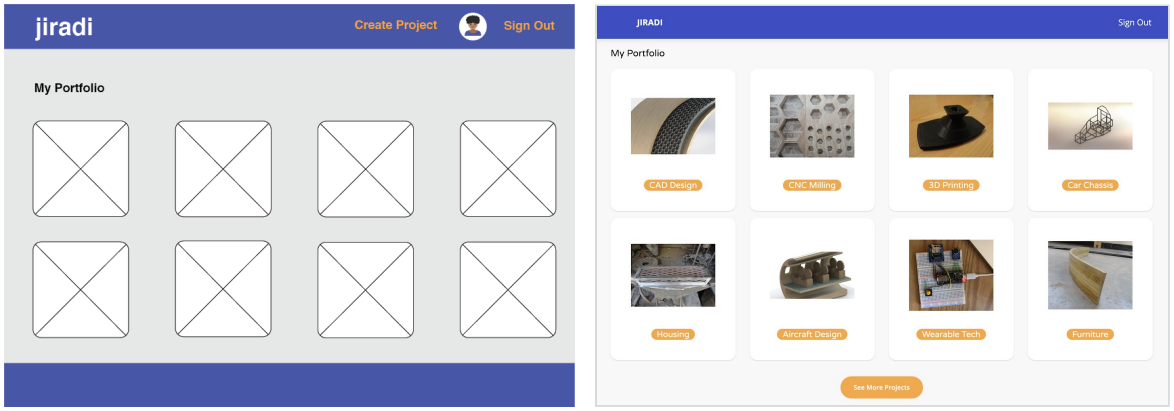


Figure 22: From left to right: Wireframe of Homepage, Mockup of Homepage.

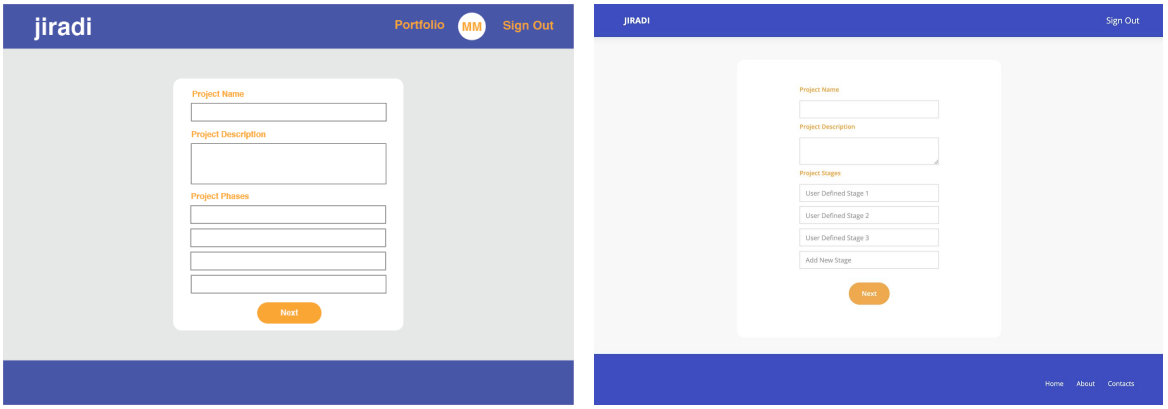


Figure 23: From left to right: Wireframe of Create Project Page, Mockup of Create Project Page.

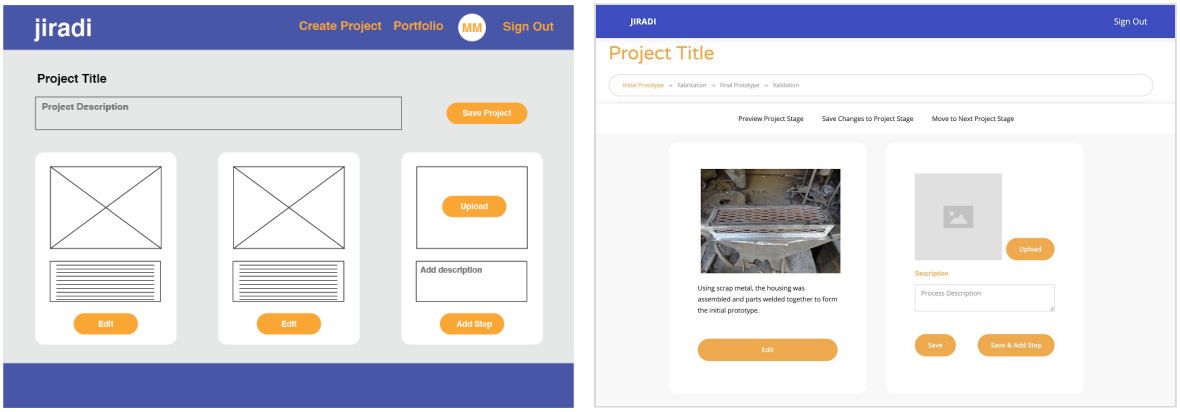


Figure 24: From left to right: Wireframe of Build Project Page, Mockup of Create Build Page.

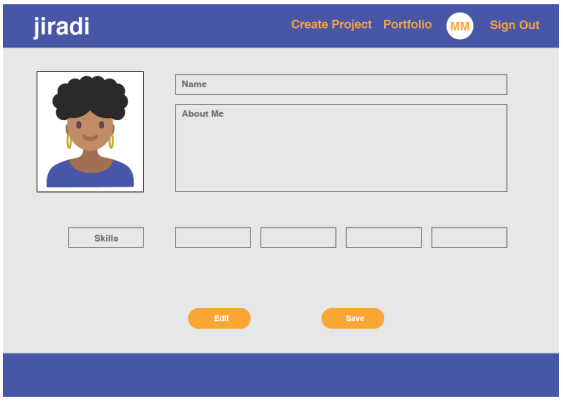


Figure 25: Wireframe of Portfolio Page.

The next step was to create a user flow to visualize the steps that a maker would take on the website to complete a task - from the point that they sign up to publishing their project to the network.

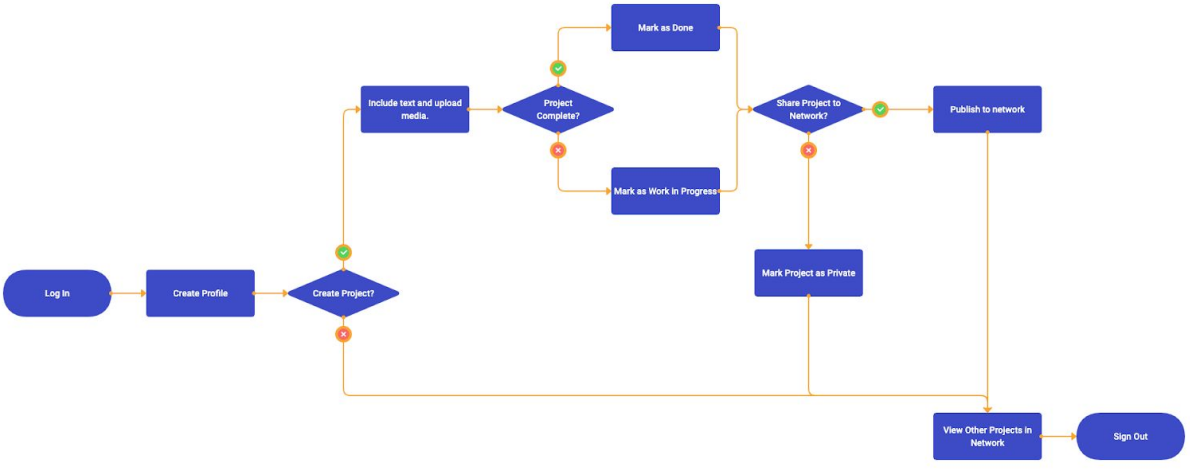


Figure 26: Initial Jiradi Userflow.

The mockups of the user interface included specific features that would be integrated into the website. The features list is shown below:

Pages	Features
	User Panel
Sign Up	First Name, Last Name, Email, Password
Log In	Email, Password, Forget Password
Homepage	List all posts, View images, View project name, View name of maker
Select Post	View steps involved to create project, View images, View description, View comment, Comment on project
Create Project	Project name, Project description, Upload image, Add phases, Add steps, Share project
Manage Project	View list of projects posted by maker, View comments, Edit project, Delete project
User Settings	Edit name, Upload profile picture, Change password, Sign Out, Delete profile
	Admin Panel
Manage Users	List of all users and view details, Edit user details, Block/Unblock users
Manage Post	List of all posts and view details, Edit posts, Delete posts

Table 5: Initial Jiradi features list.

To test the new revisions, I co-facilitated (with Juliet Wanyiri) a usability study with makers in Nairobi, Kenya. The session was held in FabLab Nairobi with 28 participants in attendance, who were all engineering students at the University of Nairobi. The 3-hour workshop was aimed to evaluate the design of Jiradi as a tool for reflective documentation.

During the usability test, the website mockups were shared with the participants to assess each of the designs. They were tasked to discuss their experience in pairs by walking through each of the pages to determine what they assumed to be the purpose of each page and its features. Each pair used a smartphone to record videos of their responses.

Figure 27: Usability test session with makers in FabLab Nairobi.

After the exercise, we discussed the following questions as a group to reflect on the experience:

- How would you use the tool?
- What did you like?
- What could be improved?
- How does the proposed website compare to other solutions?

The general opinion about the proposed website and design was that as students, the website would be useful to them to create portfolios. In addition to that, another participant added that it would help to *"monitor progress in projects."* Feedback also demonstrated that they liked the minimal design of the website and stated that it was *"simple"* and *"easy to use"*.

However, there was debate among participants with regards to privacy versus collaboration, and which between the two should be a priority - as it's difficult to achieve both without trade offs. When documenting work, makers valued the ability to connect with other makers through an online network. They suggested being able to use the tool to collaborate with other makers on projects and to share work. Makers also expressed that they value data privacy and were particularly concerned about other makers stealing their work. They suggested that there should be ways in which to authenticate work and to mitigate copyright issues.

From this, I reasoned that designing the website as an online network would satisfy the needs of many makers; however, this would raise privacy concerns and in addition to that, would require more time and resources to implement, which were beyond the scope and timeline of this thesis. On the other hand, the implications of designing it to be privately accessible are that it prevents collaboration among makers, but data would be secure and makers would feel more comfortable to create projects.

For the next iteration, I would proceed with Jiradi as a website for selecting sharing. This meant eliminating any collaboration and networking features integrated into the design. This is not to say

that such features are not important to reflective documentation, in fact, I would argue that they are characteristics which would enrich the experience for the maker and further support creative learning. After implementation and testing, future work will explore ways in which Jiradi can support peer collaboration and to test the outcomes of personal reflection with that of online sharing.

In summary, based on the feedback received the following changes were made to the design and implemented in the next iteration:

- Eliminate collaboration and networking features.
- Add a sample project on the website.
- Add a section to include materials used.
- Add tooltips to various sections.
- Redesign portfolio page to optimize for those without projects.
- Add another field to confirm password on sign up page.
- Indicate the number of characters in each text box.
- Indicate file size for images that are being uploaded.
- Ability to edit completed projects.

Third Iteration

Problem Statement: How might a portfolio-based website for reflective documentation and selective sharing be designed?

The third iteration complemented the work that was done in the second one. My intention was to incorporate all the design principles that are outlined in Chapter 7 into the final iteration, yet remain true to my goals and objectives.

With all that mind, I revised the user flow to reflect the changes to the website that would now be considered as a portfolio-based website for reflective documentation with selective sharing.

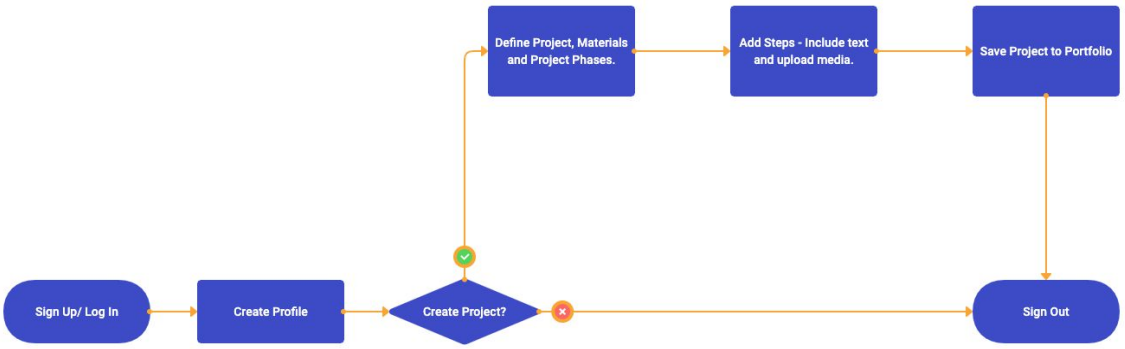


Figure 28: Updated Jiradi user flow.

I then updated the features list, as shown below:

Pages	Features
	User Panel
Sign Up	First Name, Last Name, Email, Password, Confirm Password
Log In	Email, Password, Forget Password
Homepage	List all posts, View images, View project name, Sample Project
Create Project	Project name, Project description, Upload image, Add materials used, Add date created, Add phases, Add steps, Preview project, Save project, Share project
Manage Post	View list of projects posted by the user, Edit project, Delete project
User Settings	Edit name, Upload profile picture, Change password, Logout, Delete profile
	Admin Panel
Manage Users	List of all users and view details, Edit user details, Block/ Unblock
Manage Post	List of all project and view details, Edit posts, Delete posts

Table 6: Updated Jiradi features list.

I worked with Rajni Raji to carry out the technical development (programming and developing the necessary databases), and implementation of the website. The mockups were redesigned using Adobe Photoshop and later converted to HTML to complete the user interface (UI) design. The frameworks used to develop Jiradi were Laravel for the backend and blade for the frontend. Amazon Simple Storage Service (Amazon S3) was used to provide cloud storage for images. After 9 weeks, the technical work was complete and ready for implementation.

CHAPTER 9

Maker Stories

In this chapter, I will discuss the outcomes of testing the final iteration of Jiradi with four makers in Kenya. Sections in this chapter will also highlight the documentation approach and experiences of the makers using the website.

I asked the makers to spend a week using the website to document either completed or on-going projects. At the end of the week, I set up virtual interviews online to review what they had done, and to have them provide feedback on reflective documentation in relation to the research questions introduced in Chapter 5 of this thesis. Screenshots of the portfolios created are in Appendix B.

Freshia Sackey

Age: 21

Student at Jomo Kenyatta University of Agriculture and Technology (JKUAT)

Figure 29: Photo of Freshia Sackey.

I met Freshia during the 2019 Mekatilili Fellowship Program; she was one of the participants. Since then she has been actively involved in maker networks in Kenya, championing grassroots innovation. Given her experience, I was eager to reach out to her to test Jiradi.

Freshia used Jiradi to document Walking Buddy, which is an automated walking cane for the visually impared that is aimed to assist with navigation. It was a project that was initiated by her and her brother, George Kimani, and was completed over a year prior to testing Jiradi.

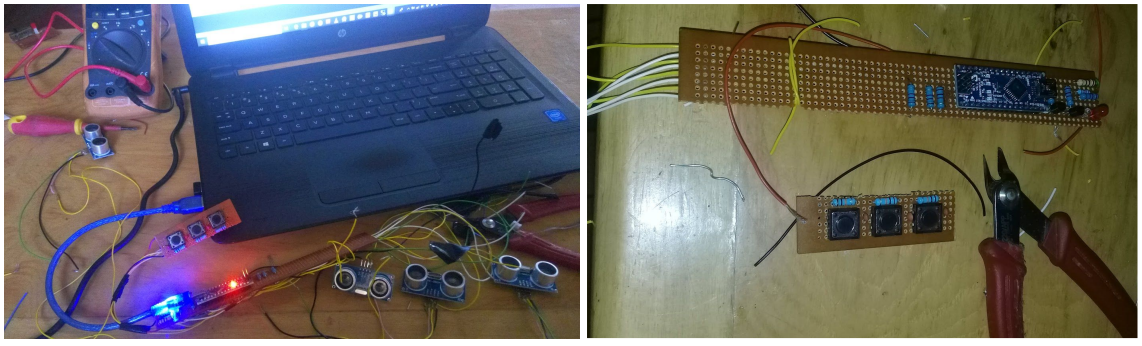


Figure 30: Images of the Walking Buddy prototype from Freshia's project. Credit: Freshia Sackey.

To begin, she structured her project into 4 stages: Research, Design, Prototyping, and Testing. According to her, this is a common structure that she uses for most of her projects, therefore it was not difficult to come up with them.

Since this was in fact her first time documenting the project, she expressed that it took a lot of recollection to fill in the various steps within the phases. The only artifacts that she had of the project were the final product and some code snippets which were scattered across various platforms. For this reason, some of the images that were used in a few steps were pulled from the Internet. She did

mention that when working on the project, she used a notebook to sketch ideas, but she did not have it at the time. She would have wanted to include these in Jiradi.

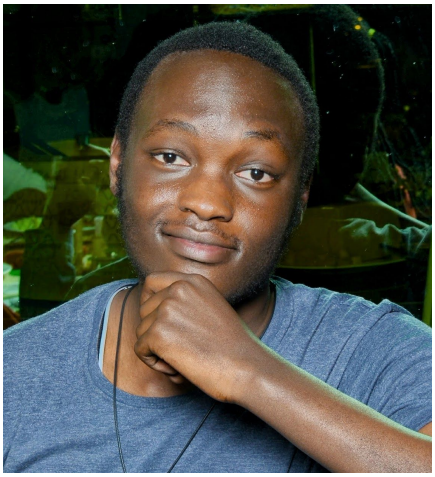
Freshia remembered that while prototyping the device, she did in fact take a few images of her work. According to her, she knew that she was working on an interesting project and that it would be nice to see in future what she did.

When discussing her experience using Jiradi, here is what she had to say:

> *I really loved documenting Walking Buddy! I feel like this is something that will put you ahead when looking for jobs or internships because this is something that a potential employer would love to look at. It makes the projects clear, it shows your whole thought process, and shows your approach to problem solving.*

Freshia also expressed that she had fun documenting her project. She said:

> *Thinking back to my project, I remembered the challenges I ran into along the way, and how I solved them. For instance, when I was using Jiradi, I recalled how I soldered the circuit, which makes me nostalgic... and when I think back, it makes me happy.*



Ian Simon

Age: 22

Student at the University of Nairobi

Figure 31: Photo of Ian Simon.

Ian was one of the participants of the usability study that was held at FabLab Nairobi. He and the rest of the participants tested the initial iteration of Jiradi and provided valuable feedback that informed the final design of the website. Since at that time he had indicated that he would like to test the completed site, I was interested to work with him to test it once again, especially because he was familiar with the previous prototype.

The project that Ian decided to document was an ongoing, team project with Vivek Goswami, whose objective was to design and fabricate a wind tunnel that could be used for the calibration of any type of digital anemometer. The team was approached by a client to develop the solution, and it's also doubling up as their undergraduate capstone project at the University of Nairobi.

Since the project serves both a professional and academic purpose, there existed a technical report, which Ian and his teammate used to update both their client and academic supervisor. During my discussion with Ian, he mentioned that before beginning the project, the client required him to share high-level project tasks and timelines, which coincided with what he used as the project phases in Jiradi. Interestingly, this reveals a valuable insight that supports the addition of project phases in the website. Since in a real-life situation, determining project phases or timelines are necessary.

The phases that he created were: Research, Analysis, Design, Fabrication, and Testing. Since the project was ongoing, not all phases had content, and at the time he was still working on the design phase of the project. He highlighted that he did not have content in the analysis phase because the work that was done consisted mostly of mathematical formulae and charts, and he was unsure of how to represent that in Jiradi. This observation touches on a challenge that was brought up in the survey on how to document non-visual experiences.

The images that he used in the Research phase were chosen from the Internet search, while those in the Design phase were his own. He revealed that since the beginning phases of most projects are usually exploratory, he tends to look for images on the Internet of similar projects for inspiration.

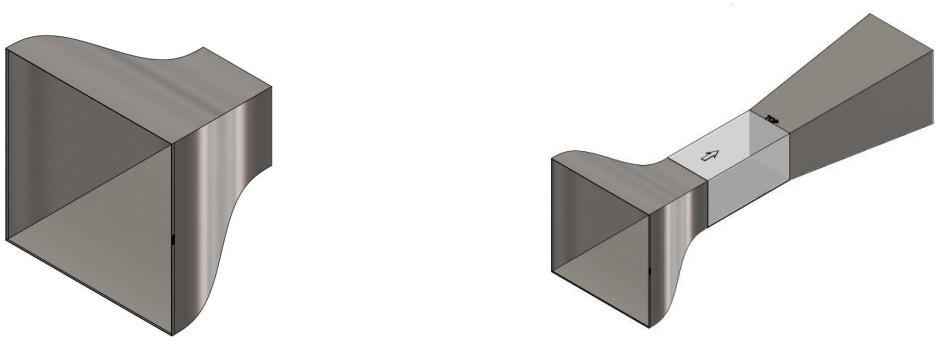


Figure 32: CAD images of a Wind Tunnel from Ian's project. Credit: Ian Simon and Vivek Goswami.

This was Ian's first experience creating a portfolio of his work and from this he learnt that he would prefer to document after the activity:

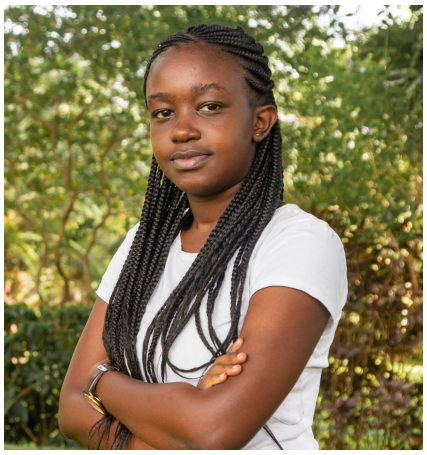
> *For a project that is ongoing, you may leave some parts incomplete. For a complete project, the content and descriptions will be comprehensive. Just like in a report, it is easier to write an abstract when you are done rather than when you are starting the report.*

However, he also understood the value of documenting during the activity. He stated that:

> *Documenting an ongoing project helps to give someone a sense of where they are going. I was able to go back and go through all that I have done in order for me to write this. So if there is any error, I can find it. If there is any improvement to be made, I can make it during the process of documenting it. I think it depends on the person. It may benefit someone who is still doing it, it may benefit someone who is done with the project.*

The opportunity to use reflective documentation helped Ian to identify areas in his work that required him to make changes:

> *For example when determining the ISO standard, there were some considerations that we had not taken into account during the research. While using Jiradi, I was able to notice this and make actual changes to my original report. This process can really help you see some things that you haven't noticed before.*



Wanjiku Mutie

Age: 22

Student at Moi University

Figure 33 : Photo of Wanjiku Mutie.

In 2017, I received an email from Wanjiku requesting to learn more information about Mekatilili. Soon after I got to know more about her and invited her to become a Mekatilili volunteer. Since then, she has been actively involved in organizing Mekatilili workshops. Based on my previous interactions with her, I felt she would be a great person to test Jiradi.

Wanjiku used Jiradi to document a class project that she was currently working on. As a student studying Chemical Engineering, she was exploring production of propylene glycol from glycerol. For this project, she was collaborating on it with her classmate, Sylvia Manono, and had been working on it for a period of 5 months. She also had been maintaining an academic report that documents the entire project from start to finish.

When deciding on the phases, Wanjiku used existing models that are based on industry standards, which had already been outlined in her report. Her phases were: Concept Stage, Process Description, Flow of Process, Heat Integration and Plant Layout. As this was still an ongoing project, all phases except Plant Layout had steps.

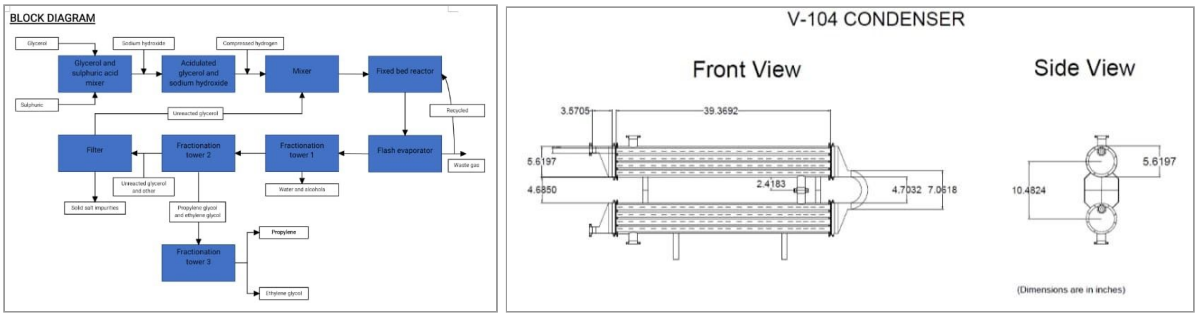


Figure 34: Images of Wanjiku's project. Credit: Wanjiku Mutie and Sylvia Manono.

Wanjiku described herself as a visual learner, therefore her usual approach to documenting involves her using her personal notebook to jot down ideas before getting started. Furthermore, her perspective towards documenting is one that is meant for an external audience, especially if it's through a website. Therefore, when using Jiradi, she anticipated that her work would be viewed by others and therefore framed her content accordingly.

Wanjiku liked the ease of Jiradi. She said, *"It's better and easier for an external viewer. It doesn't go into details, you can easily understand the general idea."* She also added that she appreciates how portfolios in Jiradi are represented using the slideshow gallery, she mentioned, *"It makes everything about my project look more attractive. It's not like the long, theoretical, and boring reports that I'm used to."*

Lastly, Jiradi helped her to make improvements on her project. She said, *"I found so many errors in my report while using Jiradi... It helped me to improve on what I already have... Reflecting really worked for me."*

Wanjiru Stella

Age: 23

Student at the University of Nairobi

Figure 35: Photo of Wanjiru Stella.

Just like Ian, Wanjiru also participated in the same usability test that was held in FabLab Nairobi. From the list of participants that had shown interest in testing Jiradi, she had indicated that she would want to get involved. During the usability test, she had provided very thoughtful feedback and I felt that it would be great to get her thoughts on the current iteration of the website.

Wanjiru took advantage of Jiradi to document two projects: one was an ongoing hobby project aimed at fabricating a wooden clock face to build her CAD skills, while the other was a project that she completed for a hackathon to develop a baby warmer.

For the wooden clock face project, her phases were: design, fabrication, and polishing. She admitted that she would have wanted to add more steps to each phase, but because of the fact that she was documenting after the activity, it was a challenge to remember everything that she had done.

Figure 36: From left to right: Wooden Clock face project, final baby warmer prototype. Credit: Wanjiru Stella.

The baby warmer project had two phases: concept design and fabrication; and seven steps in total. She mentioned that she had to look through old WhatsApp threads to find the images taken and shared during the hackathon. She had not compiled any herself. However, since the hackathon was well structured, she had enough content to use in Jiradi for this particular project.

Wanjiru revealed that using Jiradi made her feel more confident as a maker and helped her to better articulate her skills:

> *I enjoyed putting down what I've done... It really helped me to communicate better... It also made me feel like I've actually done something that's worth showing! It also reminded me of things that I went through while working on the project... it's really helpful, and you feel great when you see your portfolio.*

Moreover, the experience for her was more for personal purposes than for attracting external viewers:

> *I was documenting for myself. I didn't have it in mind that I was going to publish it or send it to anyone. I appreciate putting my work on the website without feeling judgement. There is no pressure to perform.*

Wanjiru also mentioned how using Jiradi helped her learn more: *"Using the website helped me develop even more ideas. As I was documenting, I was thinking about the various things that I could have done differently."*

CHAPTER 10

Discussion

It's at this point that I think back to the initial research questions: To what extent did I provide support to them, and thus determine the contributions that I have made through this work? I will begin this chapter by looking more broadly into this.

Lastly, four major challenges to documentation were mentioned by participants in the survey: content, media, time and effort, and technical constraints. I will conclude the chapter by discussing how Jiradi mitigates these issues through reflective documentation.

Reflecting on the Research Questions

Research Question: How might reflective documentation support creative learning in maker practices?

Critical Thinking

While using Jiradi, makers exhibited critical thinking by being able to analyze, synthesize, and evaluate pertinent information. Firstly, they had to review and breakdown their projects, then secondly, reconstruct them into categories that would align with the project phases and steps. Since for most of them, this was their first time creating a portfolio, the activity gave them the opportunity to get a fresh perspective of their work. As Freshia stated, *"...[Jiradi] shows your whole thought process, and shows your approach to problem solving."*

As a result, makers described how they were able to re-examine the project and solve problems that had previously not been identified. There were instances while testing that the makers stated that by using Jiradi, they were able to make improvements on their ongoing projects. Ian mentioned, *"I was able to notice [errors] and make actual changes to my original report. This process can really help you see some things that you haven't noticed before."* Wanjiku,

who also identified errors in her project while using Jiradi said, *"[Jiradi] helped me to improve on what I already have."*

Freedom of Expression

Based on the observations that I made from the results of having makers test the website, I picked up on the fact that the platform gave them the opportunity to creatively express themselves and build confidence in their expertise. There was no right or wrong way with regards to what a maker wanted to include in their portfolio. I also observed that they indicated that they were positively challenged to improve their communication skills, since not only did they need to describe their steps but also to be concise.

Wanjiru expressed that while using the website, there was *"no pressure to perform."* She felt open enough to document a scrappy project because she did not feel like she would be judged by other people. She added that, *"I enjoyed putting down what I've done... It also made me feel like I've actually done something that's worth showing!"*

Furthermore, others also mentioned how the experience was personal. They alluded to the fact that for them, the process was one that was meant to be for their own benefit rather than trying to adapt their work for an external audience. This means that the process was driven by personal motivation.

Research Question: How might makers better document projects for personal reflection and to showcase skills?

Embedded Scaffolding

While working on this project, I really tried to walk the fine line between agency and structure. To provide agency to makers to freely express themselves, but also to provide sufficient structure to help them easily get started. As one respondent from the survey commented that it's a challenge *"finding out how to best structure the documentation so others can find it easy to follow."*

To achieve this, I explored various iterations of the website that I tested so as to make improvements to the prototype. Although the design evolved, one thing that remained constant was the scaffolding features that were integrated into the website. These mainly included the addition of the project phases and steps, sample projects, and tool tips. I would be interested to pursue this topic further as future work, to determine the right balance to

support both planners and tinkerers. Nevertheless, with regards to reflective documentation, I believe that scaffolding is integral to supporting the concept.

Selective Sharing

For the purpose of this thesis, the focus of Jiradi was to support personal reflection and skills development. Collaboration was a factor that was touched on earlier in this document but not fully integrated in the current version of Jiradi. This is because I was interested in investigating the response from makers when given the goal to document projects for personal reflection.

Based on my research, selective sharing is an option that would appeal to learners especially when they are starting out and would like to spend their time trying out different things. For example in one of Wanjiru's projects, she included sketches that she felt *"really don't look professional."* Selective sharing encouraged her to be creatively authentic, rather than conform to certain standards.

However, sometimes, it does reach a point in their journey that they yearn to collaborate with peers or gain feedback from others about their projects. In addition to that, as they advance in their skills and gain confidence, they would like to have the option to showcase their work. Therefore, enabling sharing as an option would be an appropriate feature to incorporate in reflective documentation.

Reflecting on the Documentation Challenges

Jiradi mitages the challenges to documentation in the following ways:

Content

Jiradi is designed to provide scaffolding to documentation. This is not to limit creativity but to help organize and manage content to support reflection among makers. Makers who are not used to documenting work can easily create projects by structuring them into various phases. In addition to that, the step-by-step layout and slideshow gallery displays a visual narrative of the maker's documentation process, hence really emphasizing the 'low floors, high ceilings' design principle of the platform.

Media

To expedite implementation and testing, the current version of Jiradi only supports image files. I acknowledge that for portfolio-based websites to be effective as reflective documentation tools, it is important for them to support a range of media and to explore alternative media types. Future work will be done to expand the media types supported on the platform.

Time & Effort

The makers who tested Jiradi described it as a fun tool to use. Freshia mentioned, *"I enjoyed the process... I feel like documenting projects is something that I should have done earlier, and should continue doing."* She also expressed that the process made her feel *"nostalgic"* and *"happy"*. Similarly, Wanjiku said that using Jiradi was not like the long, theoretical, and boring reports that she's used to.

In addition to that, the majority of them implied that they were personally motivated to create portfolios. Therefore, by achieving this self-drive, documenting using Jiradi does not seem like 'just another thing to do', but rather an activity that is enjoyable and purposeful.

Technical Constraints

Research has shown that there is a digital divide in Kenya, which refers to the disparity in access to Information and Communication Technologies (Odongo & Rono, 2016). In fact, even among those with the privilege of access to these various tools and devices, there are still technical issues like poor internet connectivity, and lack of internet access. Does Jiradi solve this entire problem? No. However, Jiradi is designed to support makers with various internet connection types. Due to the minimal design of the UI, the website does not take up much bandwidth. Makers who used the site did not experience any technical difficulty and they expressed that the website and images loaded smoothly.

CHAPTER 11

Looking Ahead

Future Work in Reflective Documentation

I would like to continue to refine the concept of reflective documentation to support skills development of makers. I'm interested in designing other resources that can help to support reflective documentation, and creating playful tools that will appeal to makers.

This thesis primarily focused on Kenya, therefore going forward, I would like to implement these strategies in other contexts. I would like to investigate whether or not the same arguments still hold true, and also explore ways to adapt these tools to fit the needs of a specific context. I'm certain that it's not a one-size-fits-all solution, therefore future work would need to be done to determine how to contextualize these solutions in order to increase access to reflective documentation resources.

Future Work in Jiradi

Explore Collaboration & Skills Matching

Findings from the primary research that I conducted showed that makers value the ability to collaborate with peers. Collaboration may refer to working with others on projects, receiving feedback, sharing work, and connecting with other makers with similar interests.

This thesis focused on personal reflection and investigated its role in supporting learners to develop skills. Collaboration may also be an integral component in achieving this objective. I would be interested in exploring this concept further and integrate features that support collaboration in Jiradi.

This would mean redesigning the website to give makers the options to publicly share projects or to keep them private. For those projects that are shared publicly, they will be visible to all users of Jiradi. A public project will allow makers to provide feedback by commenting and also contacting the creator by messaging them through the platform. For makers who would prefer to use the tool for personal reflection and documentation, the website will still maintain the option to make profiles and projects private.

Moreover, following the work that was done during IDEO CoLab Design Sprint (discussed in Chapter 8), I will look into skills matching as an additional feature in Jiradi. Employers and hiring managers had shown interest in using the tool to identify suitable talent for technical roles, thus making hiring practices more efficient. Admittedly, by introducing this into Jiradi, it may affect the type of projects that makers document since they may only post completed projects in an attempt to attract employers to their profile. To determine the effects of this, I will perform A/B testing to draw comparisons between the two.

Expand Features

Admittedly, there is still a lot of work that needs to be done to Jiradi before deploying it publicly. I would like to expand the features available in the website to improve ease of use and to assist makers better to document projects.

Firstly, I will work to broaden the media types that are allowed to be uploaded into the website. As it is now, you may only upload images, but I would like to explore videos, GIFs, documents, etc. A response from the survey stated, *"It's a challenge to document things that aren't particularly visual (sound, sensory experiences; systems-level and organizational/program development work)."* I would be curious to look into the idea of capturing and uploading non-visual media types to complement documentation.

Secondly, I will add a feature that can export individual projects and portfolios into a downloadable PDF version. This feature would be necessary if the user needs a print-ready portfolio to submit for professional purposes. Instead of replicating all the work into a suitable layout, the feature will organize the projects to meet standard portfolio criteria.

Develop Mobile Application

Developing a mobile application would increase the ease of use of Jiradi and access to the website. Depending on matters regarding geographical location, economic status, and resources availability, students in Kenya (and in Africa), tend to have greater access to smartphones rather than computers or laptops (Deloitte, 2019).

The mobile app would improve access to reflective documentation tools especially in under-resourced and under-served schools and communities. Furthermore, using the mobile app, makers can simply transfer media into Jiradi, this can promote “documentation-on-the-go”.

Early in my exploration phase of this thesis, I had tinkered with creating a mobile application. During this time, I designed some UI mockups using Adobe Sketch, to view how it may look like in this version. Going forward, it would be interesting to compare how much engagement between the mobile and web app to determine, which is more desirable to makers.

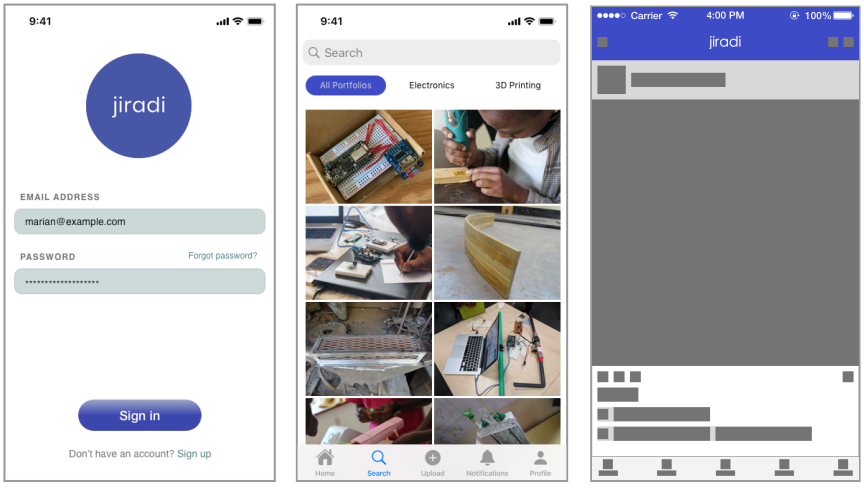


Figure 37: Mockups of proposed Jiradi mobile app.

Conclusion

I began my exploration into reflective documentation because I was inspired to look into ways in which to legitimize making in Africa as a pathway to gain skills and find meaningful work — and also to help makers gain confidence in themselves and to celebrate their maker journey. This is because, as the co-founder of Mekatilili, over the years I have come across young and talented makers who are eager to challenge misconceptions of innovation and create impact on the continent.

By no means am I the only person researching these concepts; policy makers, educators, and innovators in Africa are also doing their part to support youth. I view my work as being an additional thread that has now been woven into the intricate tapestry of ideas that make up creative learning in Africa. It’s my hope that from this thread, it will generate new and alternate strands that will form other connections that ultimately leads to a point when all children and youth have access to quality education.

Appendix A

A survey with the MIT community via mailing lists and also with technology networks in Kenya through WhatsApp groups, LinkedIn, and Facebook. A total of 49 people responded to the online survey. The survey consisted of 14 questions and aimed to explore how learners showcase their projects and skills, preferred tools and methods utilized, motivations and challenges, and collaboration practices. The results of the survey are discussed in Chapter 6.

* 1 Do you have an online portfolio?

2 (If answer is yes to question 1)

2a Which tools do you use to help you document your project?

- Behance
- Dribble
- Github
- Squarespace
- Wordpress
- Wix
- Strikingly
- Google sites
- Adobe Portfolio
- Other

2b Why do you prefer the tool(s) that you selected above?

2c How many projects have you documented?

- 1
- 2-5
- 6-10
- >10

2d Briefly describe the process of documenting your projects.

2e How did you learn to structure your portfolio?

- Inspiration from other design portfolios.
- Guidance from lecturers, career advisors, friends, etc.
- Self-taught (Self-inspired)
- An Internet search on how to structure a technical portfolios.

2f What are your motivations for documenting your projects and sharing them online?

2g How do you determine the readiness of your portfolio?

2h How often do you update your portfolio?

- Often
- Always
- Sometimes
- Rarely
- Never

2i What determines how frequently you update your portfolio?

2j What is your biggest challenge when documenting your work?

3 (If answer is no to question 2)

3a What prevents you from building a portfolio?

* 4 How frequently do you collaborate on projects?

- Often
- Always
- Sometimes
- Rarely
- Never

* 5 Which online resources do you use to discover new job opportunities?

* 6 Why do you prefer the resource(s) that you selected above?

* 7 Which city are you based in?

* 8 Highest level of education attained?

- High School
- Bachelors
- Masters
- PhD

* 9 Employment Status

- Student
- Employed
- Self-Employed
- Seeking Employment

* 10 Age Range?

- 18 or younger
- 19 - 24
- 25 - 34
- 35 - 40
- 41 - 50
- 51 - 60
- 61+

* 11 Gender?

- Female
- Male
- I would rather not say

12 If selected as one of the recipients of the gift card, which is your preferred email address for us to contact you?

* 13 Would you be interested in being contacted to have a follow up conversation based on your response?

14 (If answer is yes to question 13)

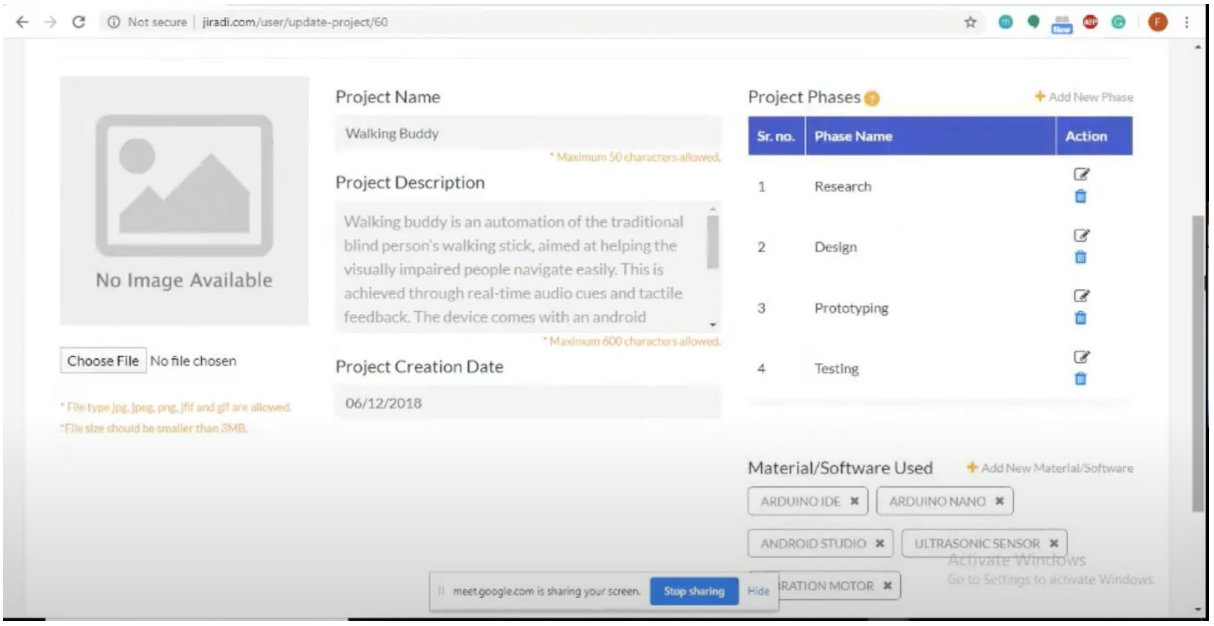
14a Name

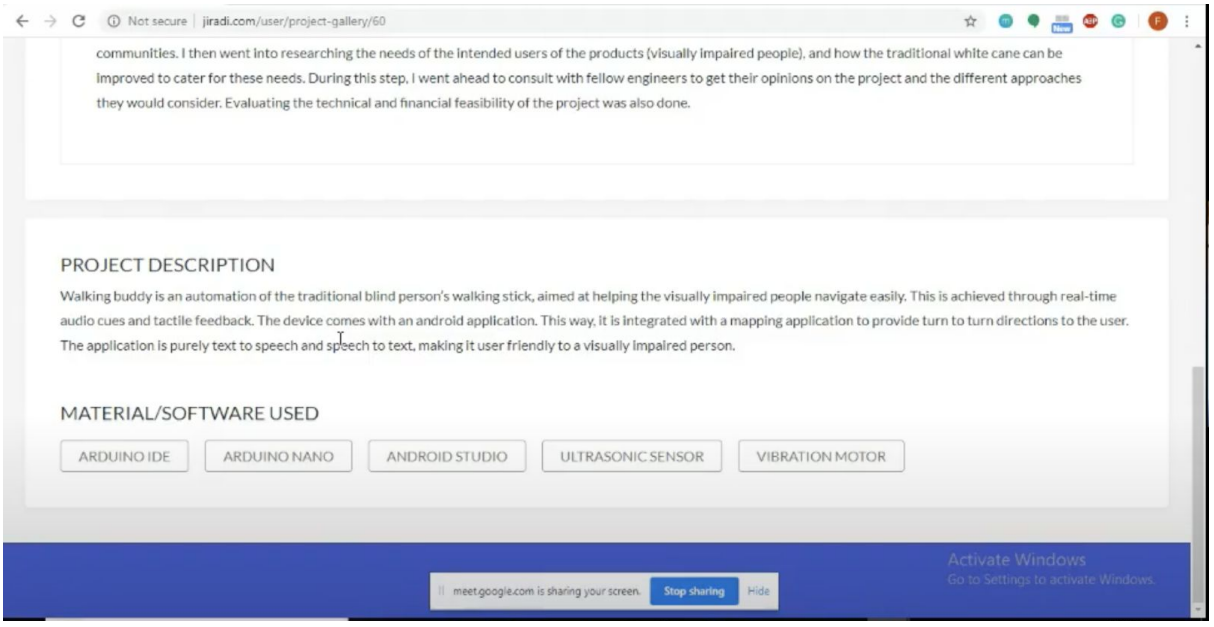
14b Email Address

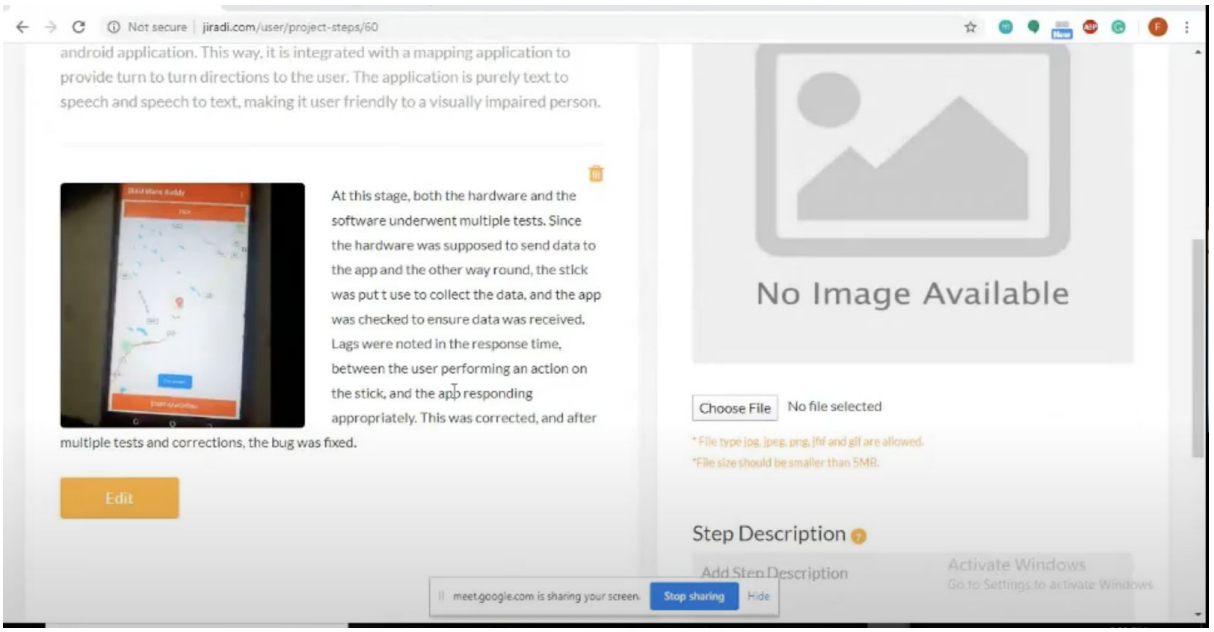
Appendix B

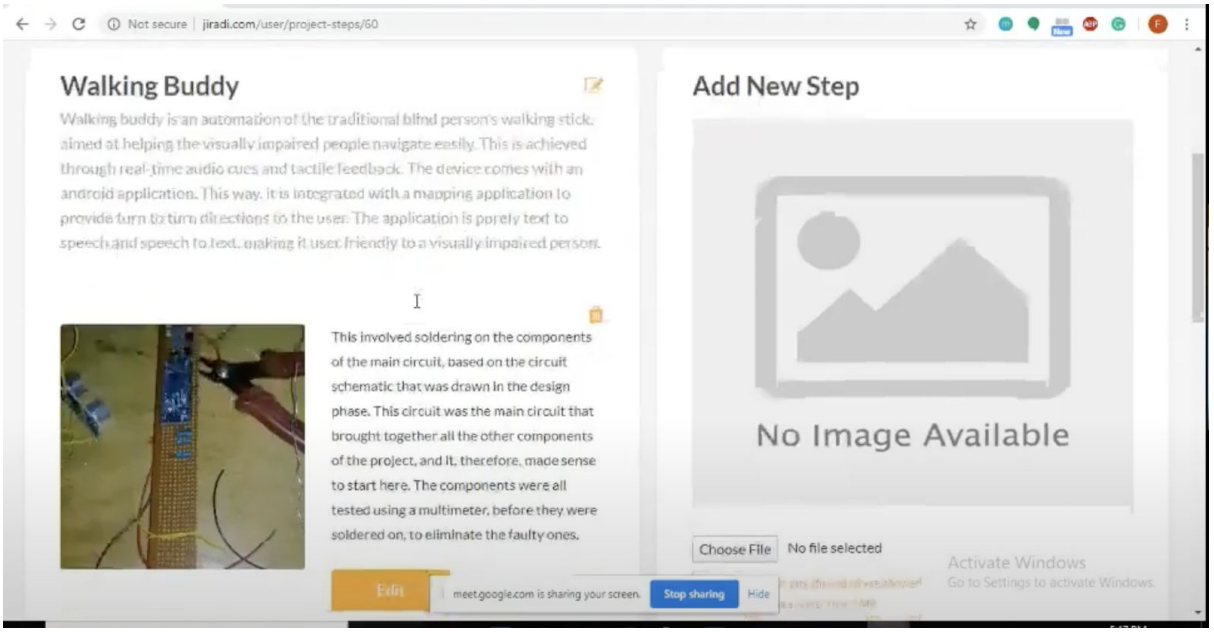
This section includes screenshots of sections from portfolios created by Freshia, Ian, Wanjiku, and Wanjiru, using Jiradi.

Freshia

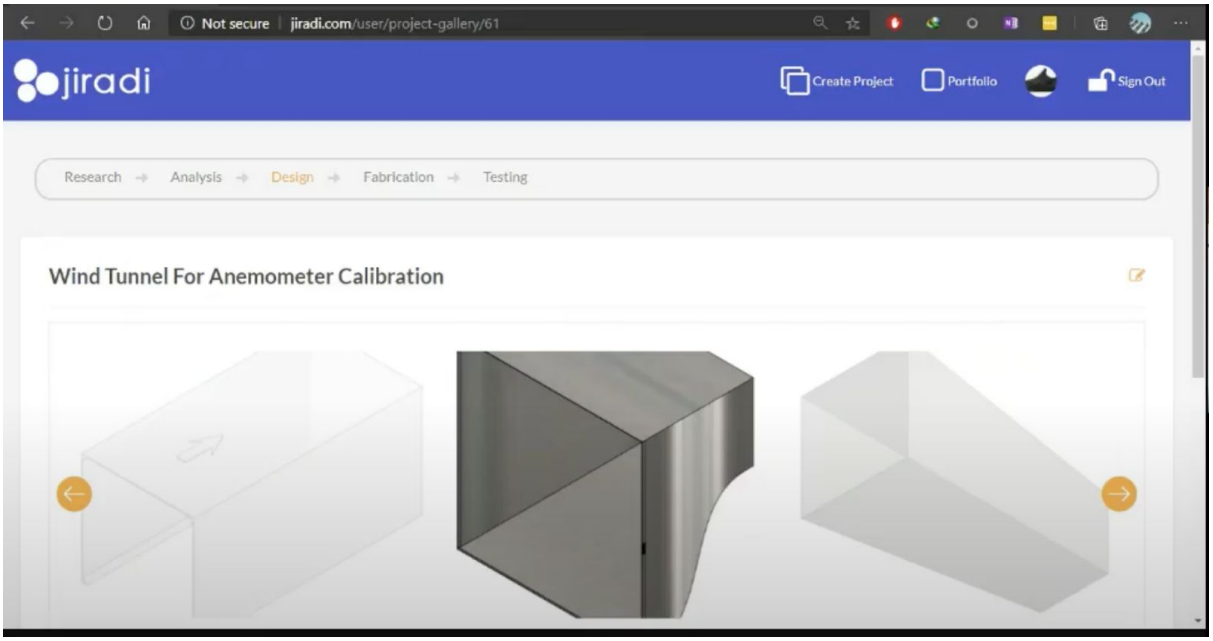

Not secure | jiradi.com/user/update-project/60
No Image Available
Choose File No file chosen
* File type jpg, jpeg, png, jfif and gif are allowed.
*File size should be smaller than 3MB.
Project Name
Walking Buddy
* Maximum 50 characters allowed.
Project Description
Walking buddy is an automation of the traditional blind person's walking stick, aimed at helping the visually impaired people navigate easily. This is achieved through real-time audio cues and tactile feedback. The device comes with an android
* Maximum 600 characters allowed.
Project Creation Date
06/12/2018
Project Phases
+ Add New Phase
Sr. no.
Phase Name
Action
1 Research
2 Design
3 Prototyping
4 Testing
Material/Software Used
+ Add New Material/Software
ARDUINO IDE
ARDUINO NANO
ANDROID STUDIO
ULTRASONIC SENSOR
meet.google.com is sharing your screen.
Stop sharing
Hide

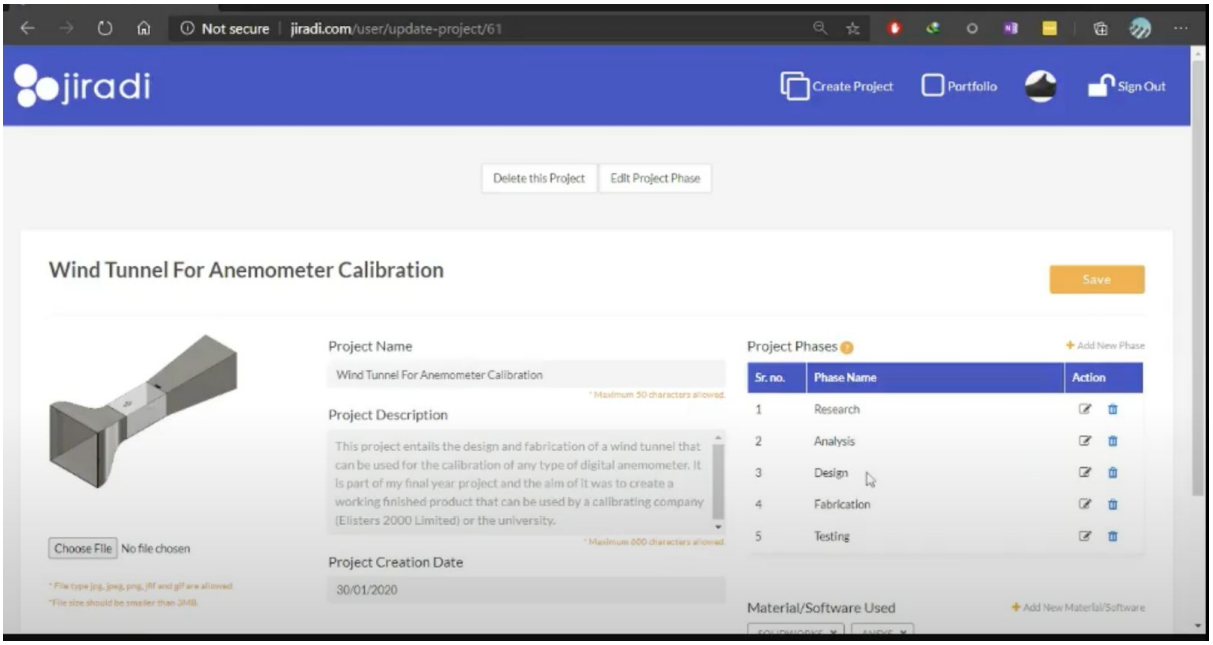

Not secure | jiradi.com/user/project-gallery/60
communities. I then went into researching the needs of the intended users of the products (visually impaired people), and how the traditional white cane can be improved to cater for these needs. During this step, I went ahead to consult with fellow engineers to get their opinions on the project and the different approaches they would consider. Evaluating the technical and financial feasibility of the project was also done.
PROJECT DESCRIPTION
Walking buddy is an automation of the traditional blind person's walking stick, aimed at helping the visually impaired people navigate easily. This is achieved through real-time audio cues and tactile feedback. The device comes with an android application. This way, it is integrated with a mapping application to provide turn to turn directions to the user. The application is purely text to speech and speech to text, making it user friendly to a visually impaired person.
MATERIAL/SOFTWARE USED
ARDUINO IDE
ARDUINO NANO
ANDROID STUDIO
ULTRASONIC SENSOR
VIBRATION MOTOR
meet.google.com is sharing your screen.
Stop sharing
Hide

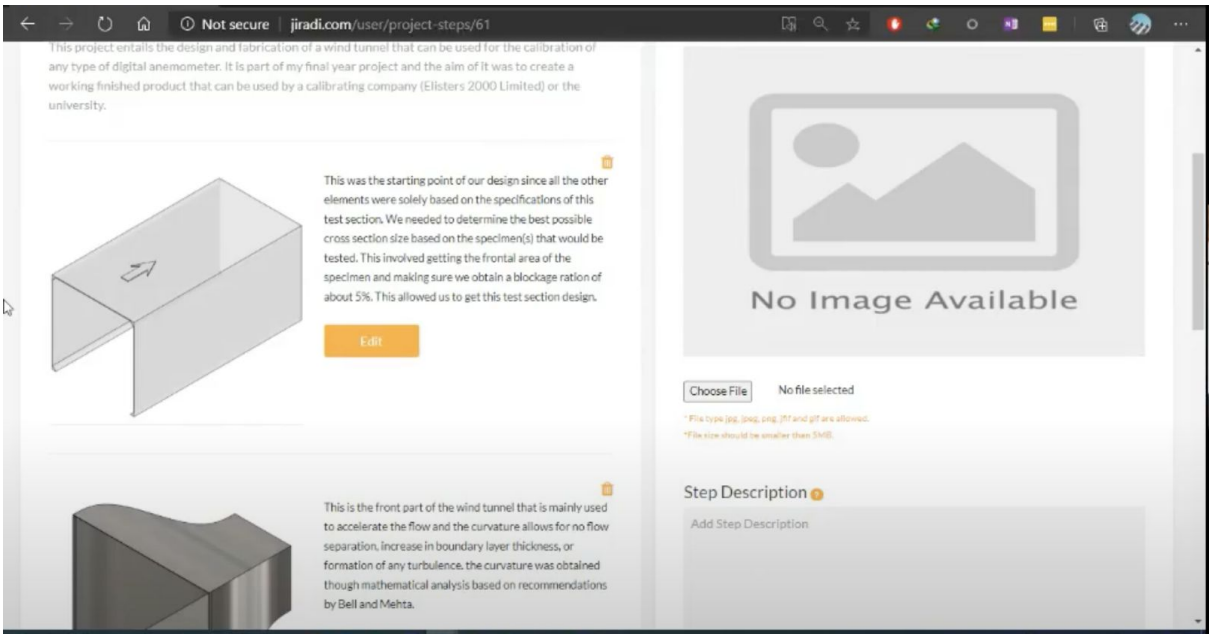

Not secure | jiradi.com/user/project-steps/60
android application. This way, it is integrated with a mapping application to provide turn to turn directions to the user. The application is purely text to speech and speech to text, making it user friendly to a visually impaired person.
At this stage, both the hardware and the software underwent multiple tests. Since the hardware was supposed to send data to the app and the other way round, the stick was put t use to collect the data, and the app was checked to ensure data was received. Lags were noted in the response time, between the user performing an action on the stick, and the app responding appropriately. This was corrected, and after multiple tests and corrections, the bug was fixed.
Edit
No Image Available
Choose File
No file selected
Step Description
Add Step Description
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

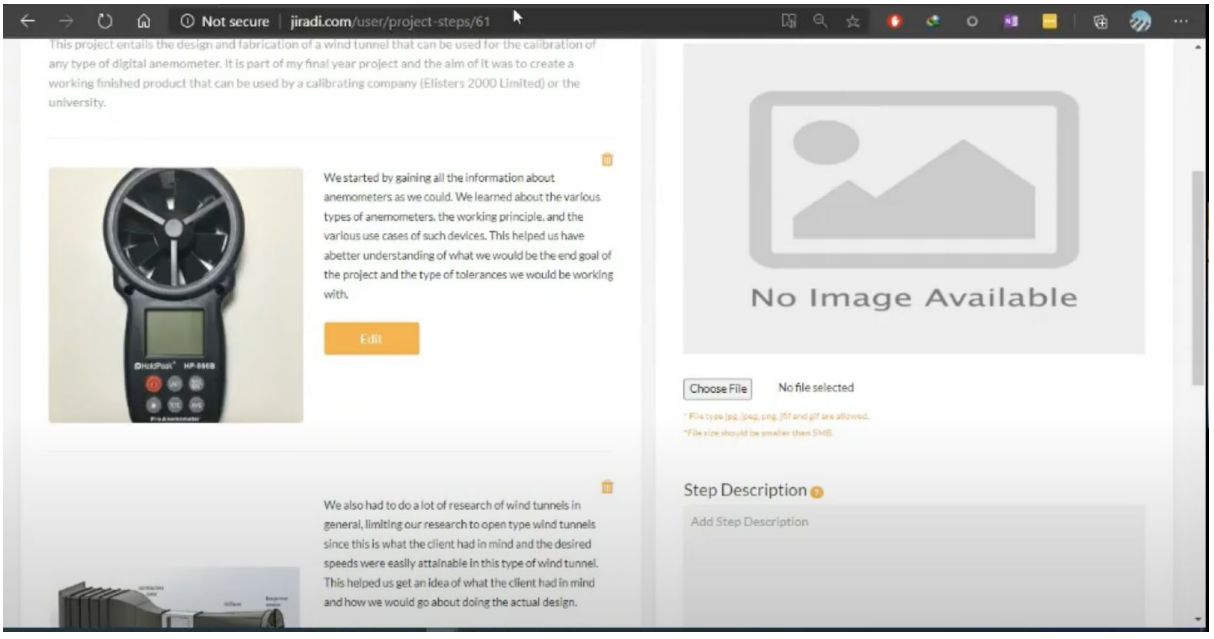

Not secure | jiradi.com/user/project-steps/60
Walking Buddy
Walking buddy is an automation of the traditional blind person's walking stick, aimed at helping the visually impaired people navigate easily. This is achieved through real-time audio cues and tactile feedback. The device comes with an android application. This way, it is integrated with a mapping application to provide turn to turn directions to the user. The application is purely text to speech and speech to text, making it user friendly to a visually impaired person.
This involved soldering on the components of the main circuit, based on the circuit schematic that was drawn in the design phase. This circuit was the main circuit that brought together all the other components of the project, and it, therefore, made sense to start here. The components were all tested using a multimeter, before they were soldered on, to eliminate the faulty ones.
Edit
Add New Step
No Image Available
Choose File
No file selected
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

Ian

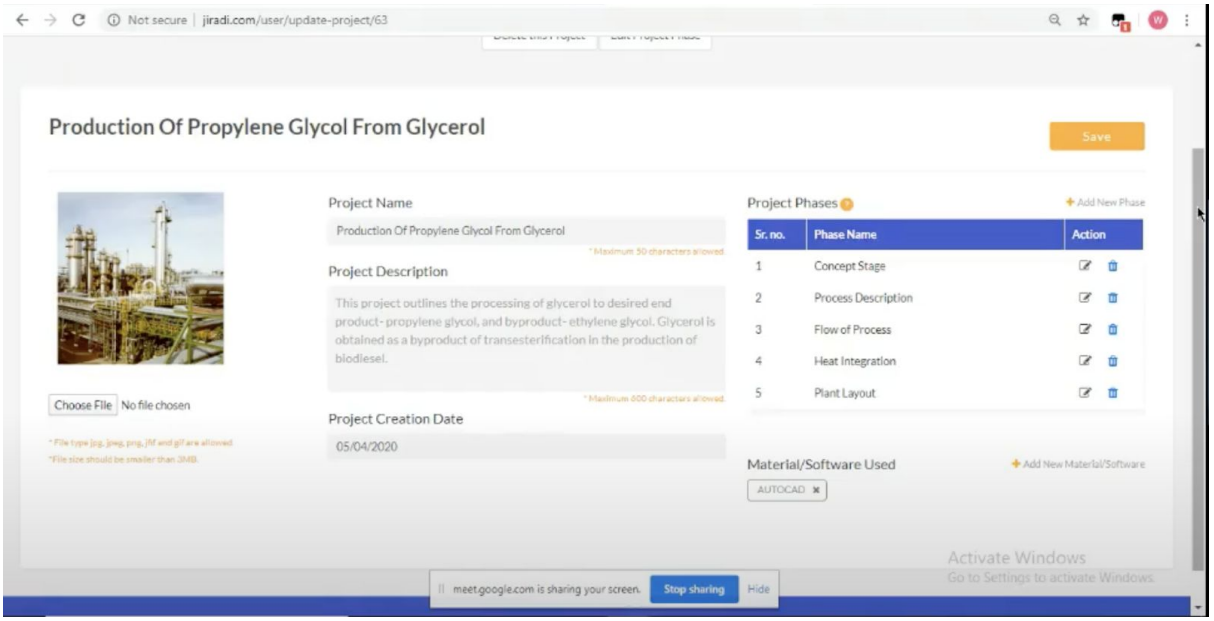

Not secure | jiradi.com/user/project-gallery/61
jiradi
Create Project
Portfolio
Sign Out
Research
Analysis
Design
Fabrication
Testing
Wind Tunnel For Anemometer Calibration

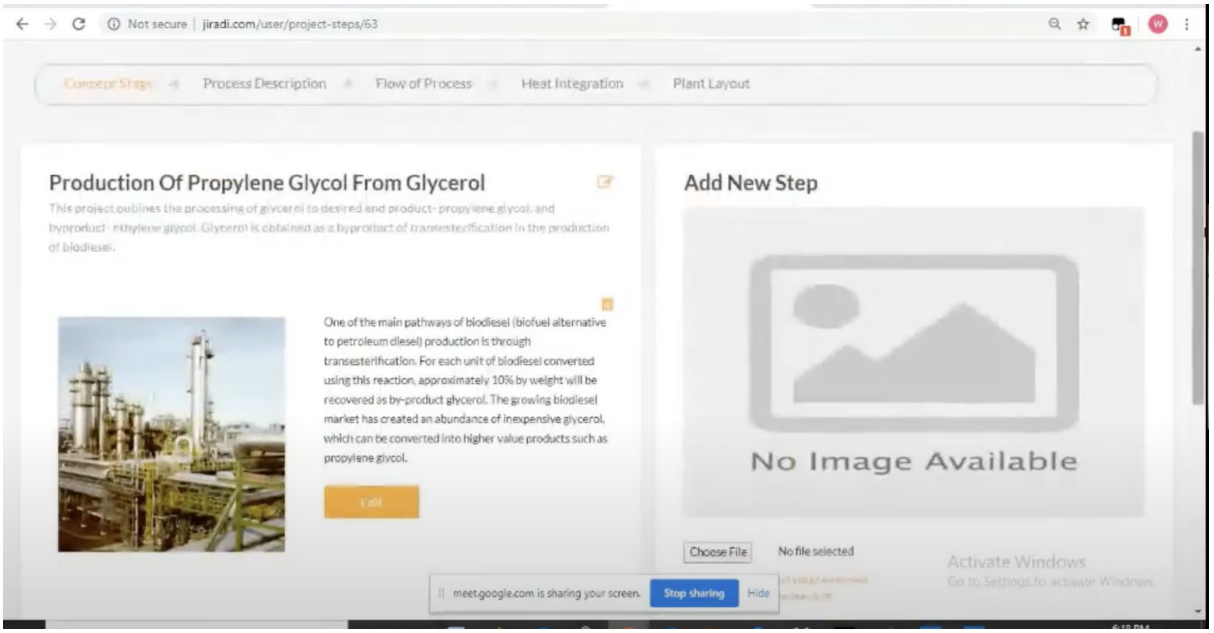

Not secure | jiradi.com/user/update-project/61
jiradi
Create Project
Portfolio
Sign Out
Delete this Project
Edit Project Phase
Wind Tunnel For Anemometer Calibration
Save
Project Name
Wind Tunnel For Anemometer Calibration
Project Description
This project entails the design and fabrication of a wind tunnel that can be used for the calibration of any type of digital anemometer. It is part of my final year project and the aim of it was to create a working finished product that can be used by a calibrating company (Elisters 2000 Limited) or the university.
Project Creation Date
30/01/2020
Choose File
No file chosen
Project Phases
Add New Phase
Sr. no.
Phase Name
Action
1 Research
2 Analysis
3 Design
4 Fabrication
5 Testing
Material/Software Used
Add New Material/Software

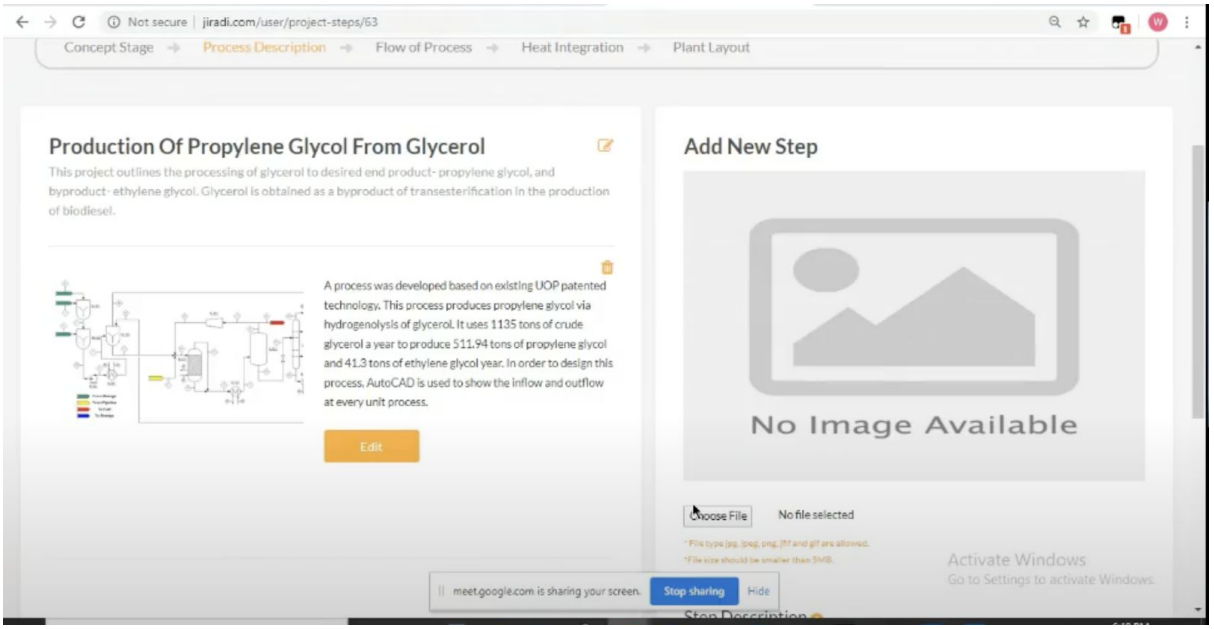

Not secure | jiradi.com/user/project-steps/61
This project entails the design and fabrication of a wind tunnel that can be used for the calibration of any type of digital anemometer. It is part of my final year project and the aim of it was to create a working finished product that can be used by a calibrating company (Elisters 2000 Limited) or the university.
This was the starting point of our design since all the other elements were solely based on the specifications of this test section. We needed to determine the best possible cross section size based on the specimen(s) that would be tested. This involved getting the frontal area of the specimen and making sure we obtain a blockage ration of about 5%. This allowed us to get this test section design.
Edit
No Image Available
Choose File
No file selected
This is the front part of the wind tunnel that is mainly used to accelerate the flow and the curvature allows for no flow separation, increase in boundary layer thickness, or formation of any turbulence. the curvature was obtained though mathematical analysis based on recommendations by Bell and Mehta.
Step Description
Add Step Description

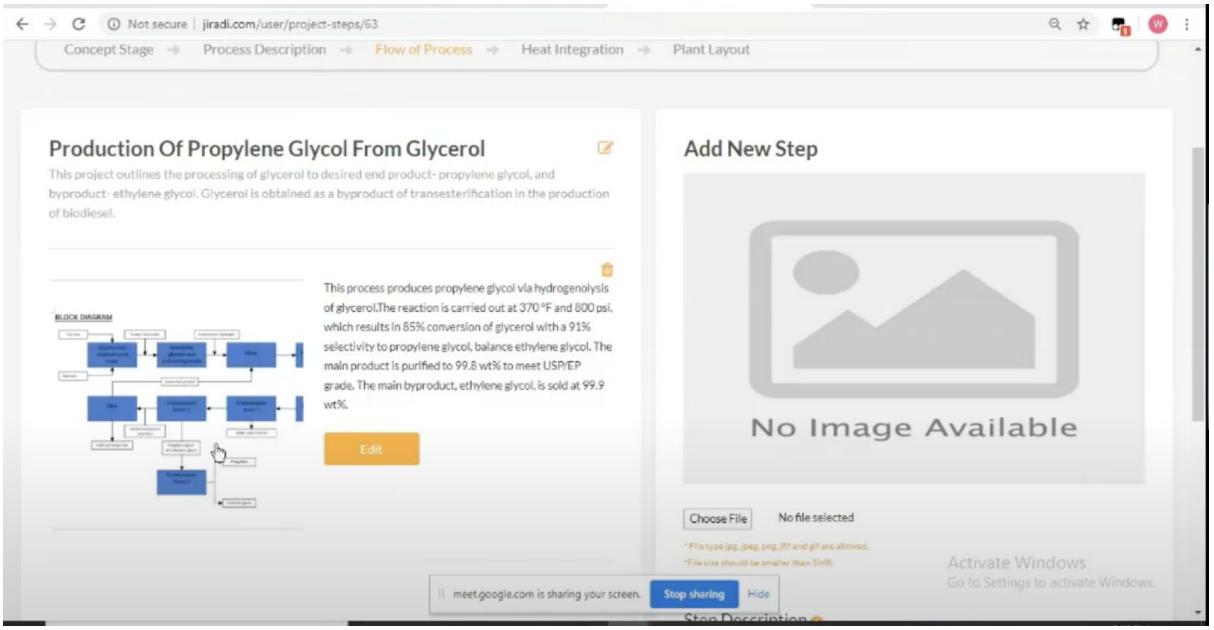

Not secure | jiradi.com/user/project-steps/61
This project entails the design and fabrication of a wind tunnel that can be used for the calibration of any type of digital anemometer. It is part of my final year project and the aim of it was to create a working finished product that can be used by a calibrating company (Elisters 2000 Limited) or the university.
We started by gaining all the information about anemometers as we could. We learned about the various types of anemometers, the working principle, and the various use cases of such devices. This helped us have abetter understanding of what we would be the end goal of the project and the type of tolerances we would be working with.
Edit
No Image Available
Choose File
No file selected
We also had to do a lot of research of wind tunnels in general, limiting our research to open type wind tunnels since this is what the client had in mind and the desired speeds were easily attainable in this type of wind tunnel. This helped us get an idea of what the client had in mind and how we would go about doing the actual design.
Step Description
Add Step Description

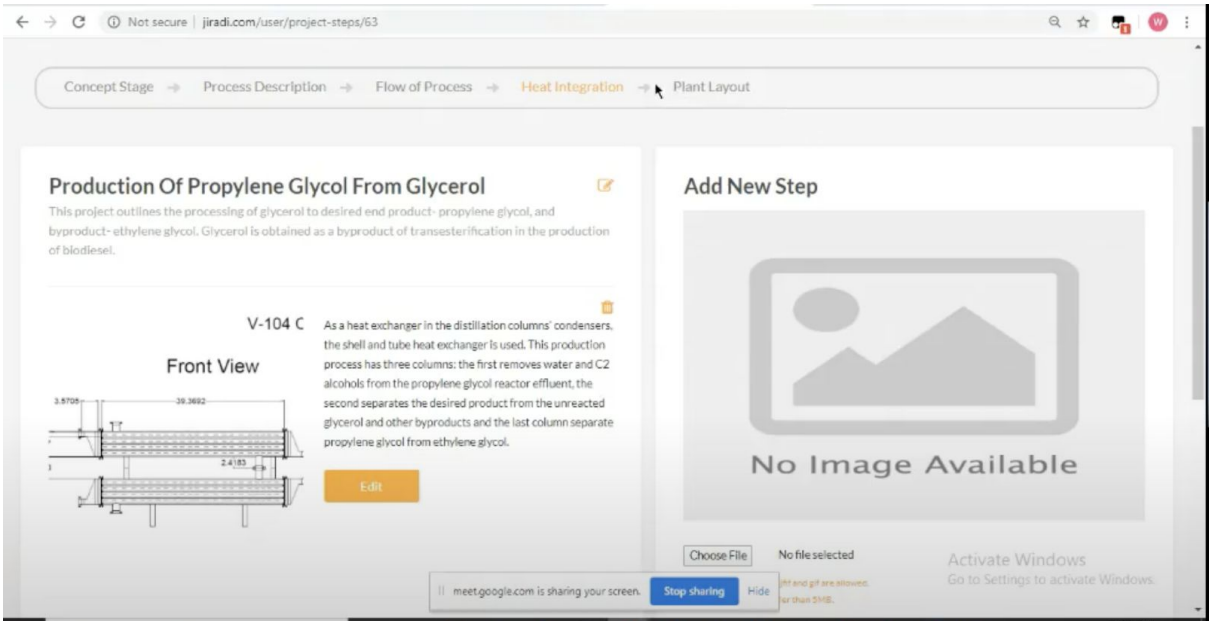
Wanjiku


Not secure | jiradi.com/user/update-project/63
Production Of Propylene Glycol From Glycerol
Save
Project Name
Production Of Propylene Glycol From Glycerol
Project Description
This project outlines the processing of glycerol to desired end product- propylene glycol, and byproduct- ethylene glycol. Glycerol is obtained as a byproduct of transesterification in the production of biodiesel.
Project Creation Date
05/04/2020
Choose File
No file chosen
Project Phases
Add New Phase
Sr. no.
Phase Name
Action
1 Concept Stage
2 Process Description
3 Flow of Process
4 Heat Integration
5 Plant Layout
Material/Software Used
Add New Material/Software
AUTOCAD
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

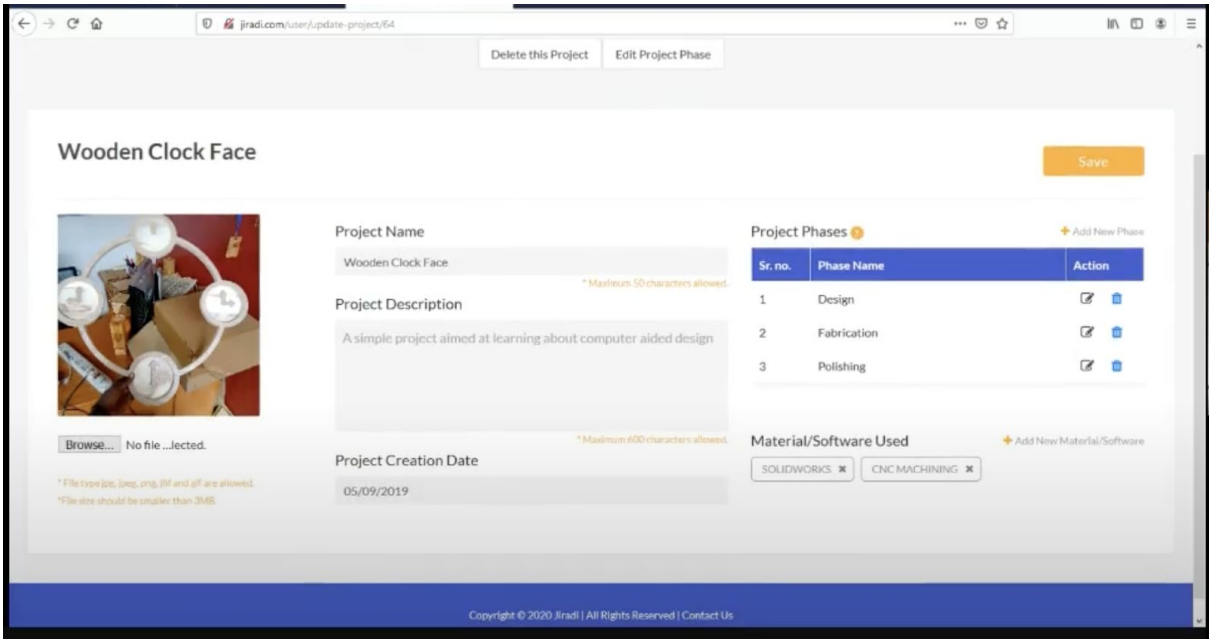

Not secure | jiradi.com/user/project-steps/63
Concept Stage
Process Description
Flow of Process
Heat Integration
Plant Layout
Production Of Propylene Glycol From Glycerol
This project outlines the processing of glycerol to desired end product- propylene glycol, and byproduct- ethylene glycol. Glycerol is obtained as a byproduct of transesterification in the production of biodiesel.
One of the main pathways of biodiesel (biofuel alternative to petroleum diesel) production is through transesterification. For each unit of biodiesel converted using this reaction, approximately 10% by weight will be recovered as by-product glycerol. The growing biodiesel market has created an abundance of inexpensive glycerol, which can be converted into higher value products such as propylene glycol.
Edit
Add New Step
No Image Available
Choose File
No file selected
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

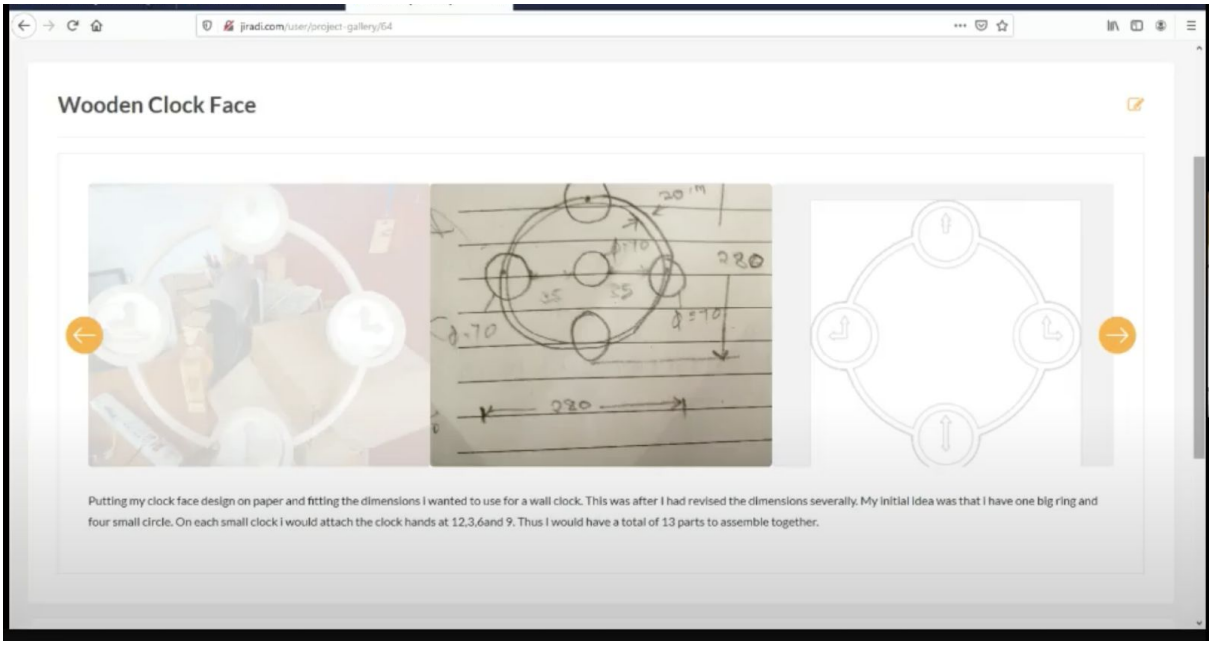

Not secure | jiradi.com/user/project-steps/63
Concept Stage
Process Description
Flow of Process
Heat Integration
Plant Layout
Production Of Propylene Glycol From Glycerol
This project outlines the processing of glycerol to desired end product- propylene glycol, and byproduct- ethylene glycol. Glycerol is obtained as a byproduct of transesterification in the production of biodiesel.
A process was developed based on existing UOP patented technology. This process produces propylene glycol via hydrogenolysis of glycerol. It uses 1135 tons of crude glycerol a year to produce 511.94 tons of propylene glycol and 41.3 tons of ethylene glycol year. In order to design this process, AutoCAD is used to show the inflow and outflow at every unit process.
Edit
Add New Step
No Image Available
Choose File
No file selected
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

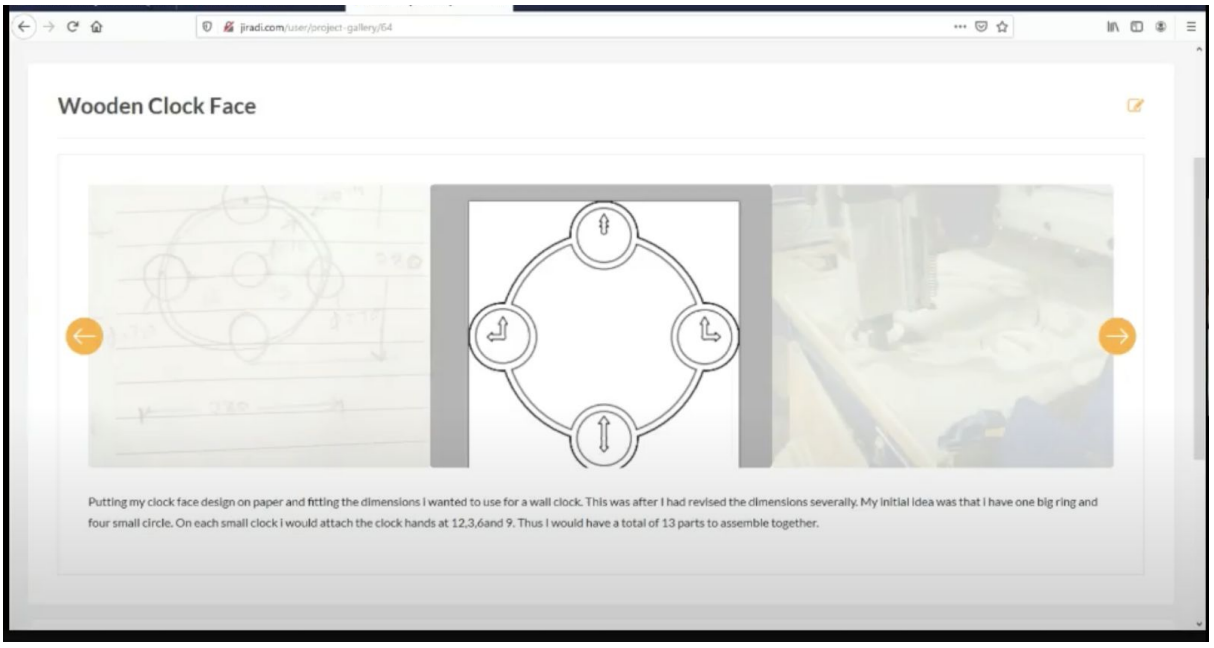

Not secure | jiradi.com/user/project-steps/63
Concept Stage
Process Description
Flow of Process
Heat Integration
Plant Layout
Production Of Propylene Glycol From Glycerol
This project outlines the processing of glycerol to desired end product- propylene glycol, and byproduct- ethylene glycol. Glycerol is obtained as a byproduct of transesterification in the production of biodiesel.
BLOCK DIAGRAM
This process produces propylene glycol via hydrogenolysis of glycerol.The reaction is carried out at 370 °F and 800 psi, which results in 85% conversion of glycerol with a 91% selectivity to propylene glycol, balance ethylene glycol. The main product is purified to 99.8 wt% to meet USP/EP grade. The main byproduct, ethylene glycol, is sold at 99.9 wt%.
Edit
Add New Step
No Image Available
Choose File
No file selected
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

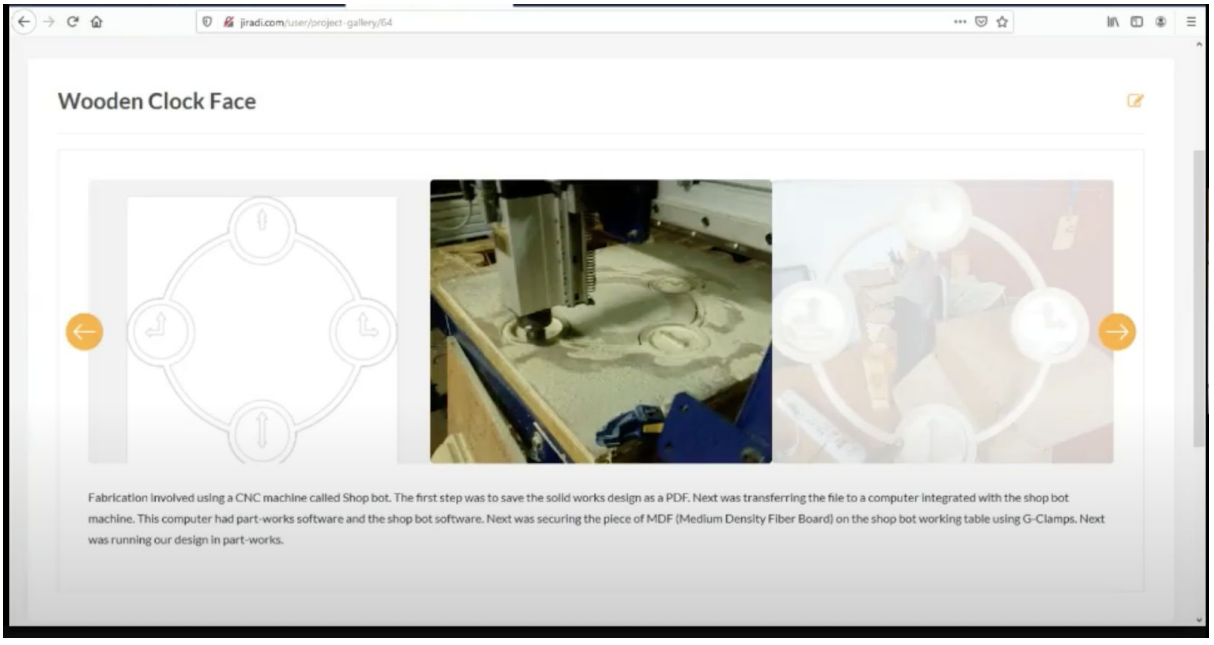

Not secure | jiradi.com/user/project-steps/63
Concept Stage
Process Description
Flow of Process
Heat Integration
Plant Layout
Production Of Propylene Glycol From Glycerol
This project outlines the processing of glycerol to desired end product- propylene glycol, and byproduct- ethylene glycol. Glycerol is obtained as a byproduct of transesterification in the production of biodiesel.
V-104 C
Front View
As a heat exchanger in the distillation columns' condensers, the shell and tube heat exchanger is used. This production process has three columns: the first removes water and C2 alcohols from the propylene glycol reactor effluent, the second separates the desired product from the unreacted glycerol and other byproducts and the last column separate propylene glycol from ethylene glycol.
Edit
Add New Step
No Image Available
Choose File
No file selected
meet.google.com is sharing your screen.
Stop sharing
Hide
Activate Windows
Go to Settings to activate Windows.

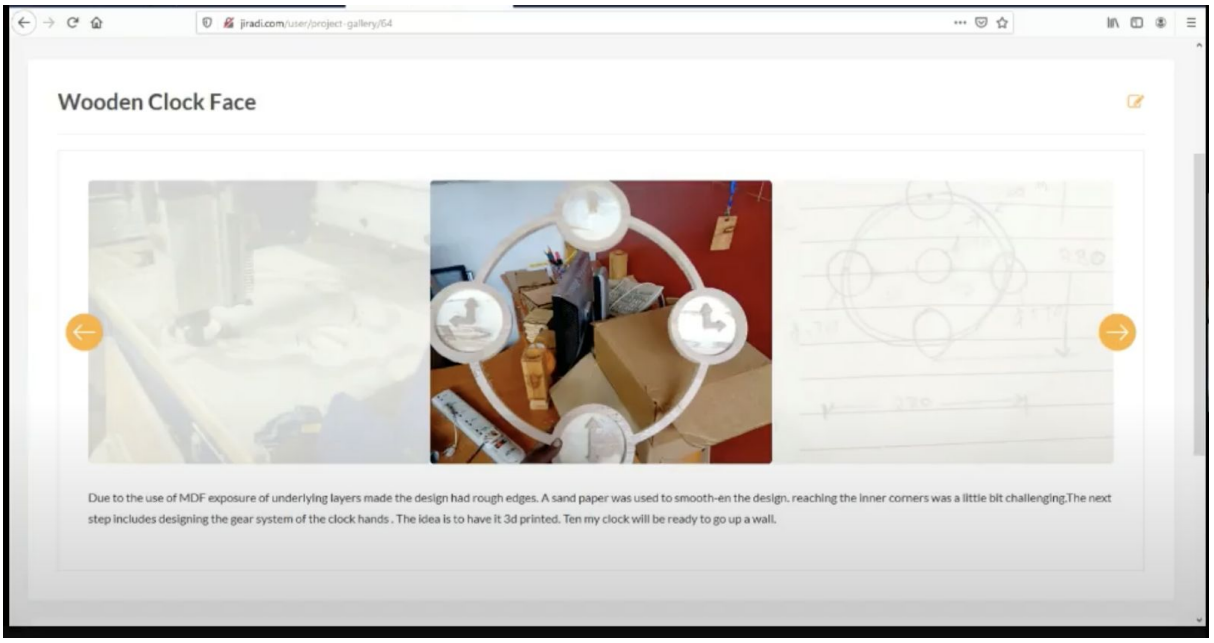
Wanjiru

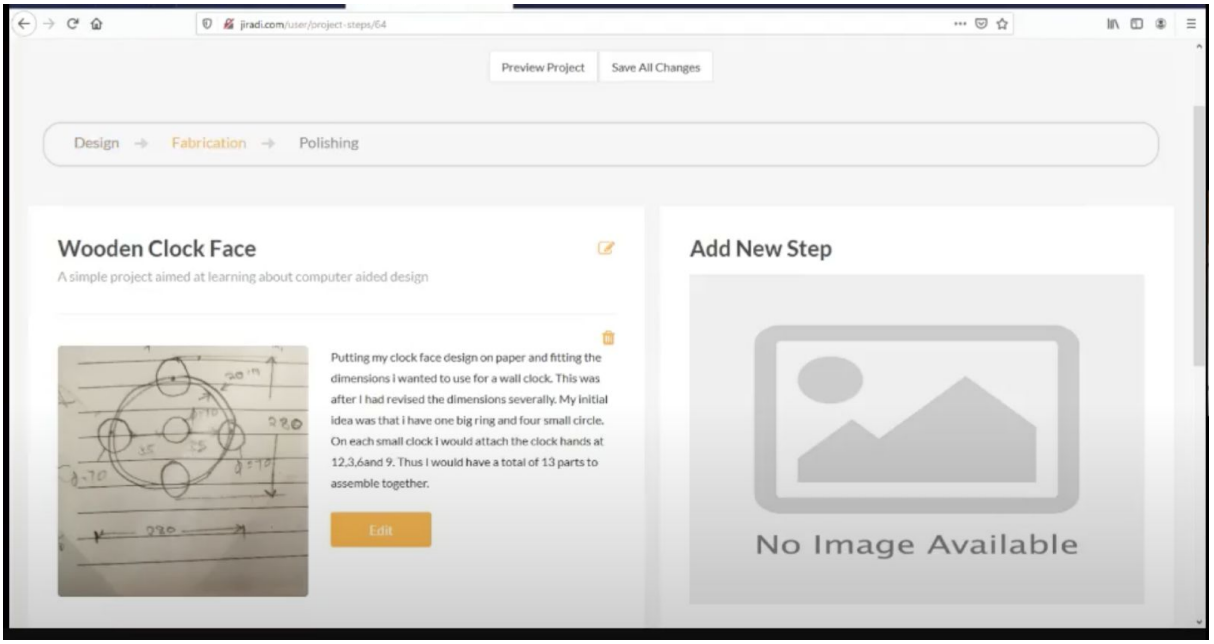

jiradi.com/user/update-project/64
Delete this Project
Edit Project Phase
Wooden Clock Face
Save
Project Name
Wooden Clock Face
Project Description
A simple project aimed at learning about computer aided design
Project Creation Date
05/09/2019
Project Phases
Add New Phase
Sr. no.
Phase Name
Action
1
Design
2
Fabrication
3
Polishing
Material/Software Used
Add New Material/Software
SOLIDWORKS
CNC MACHINING
Browse...
No file ...lected.
Copyright © 2020 Jiradi | All Rights Reserved | Contact Us

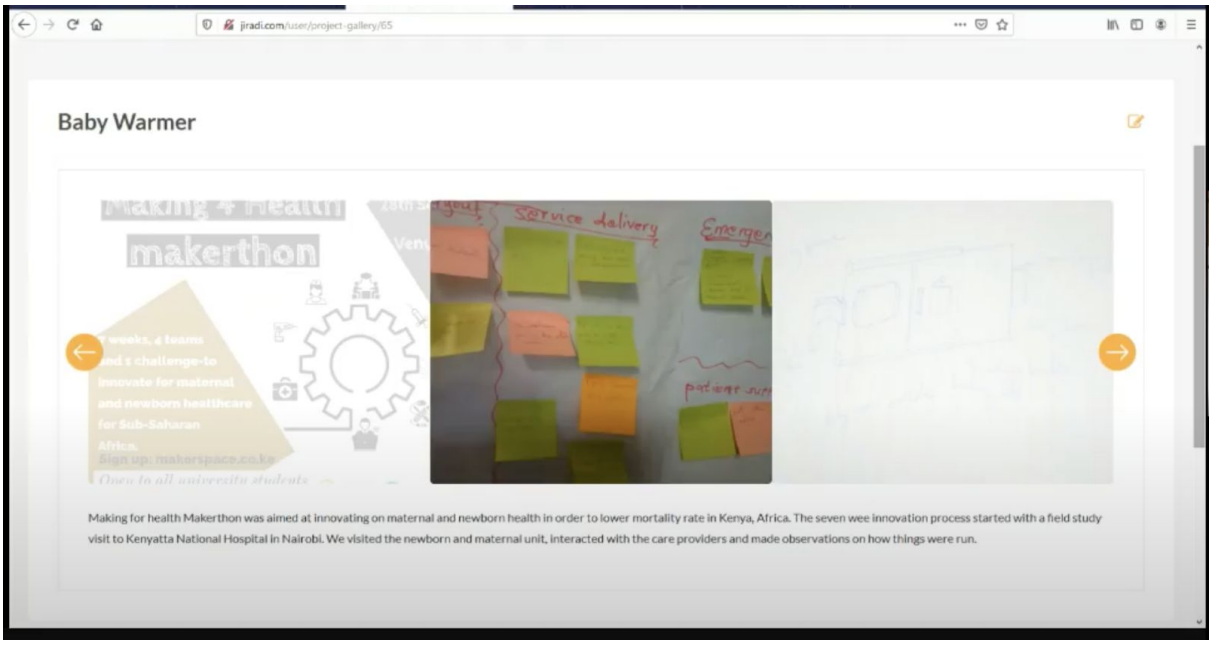

jiradi.com/user/project-gallery/64
Wooden Clock Face
Putting my clock face design on paper and fitting the dimensions I wanted to use for a wall clock. This was after I had revised the dimensions severally. My initial idea was that I have one big ring and four small circle. On each small clock i would attach the clock hands at 12,3,6and 9. Thus I would have a total of 13 parts to assemble together.

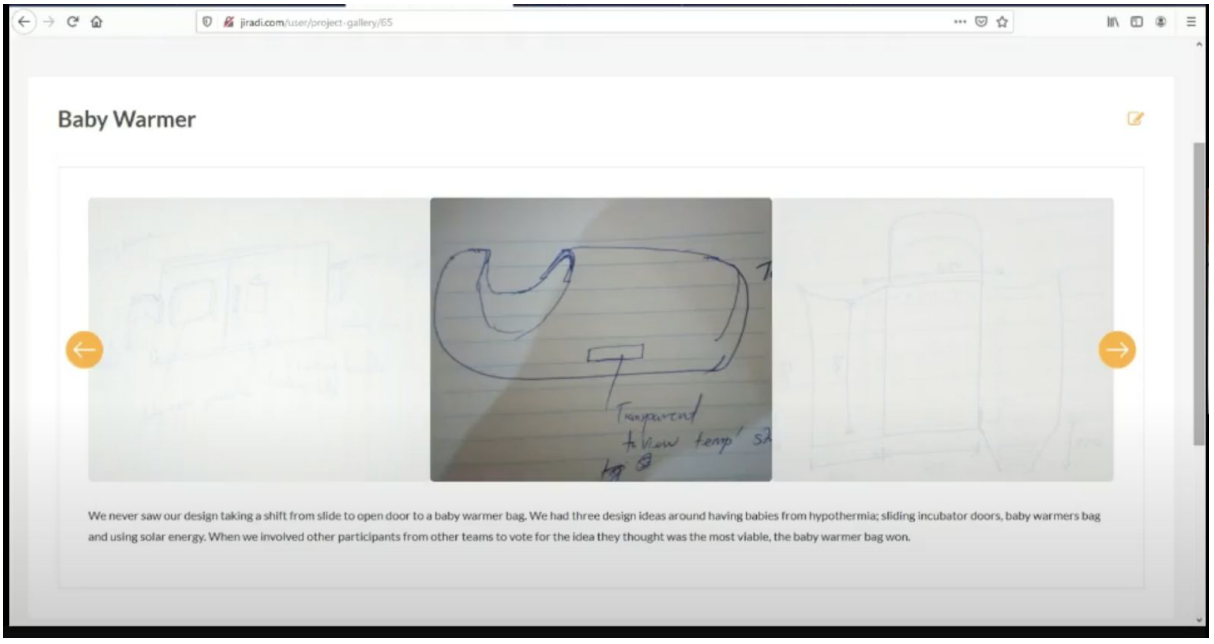

jiradi.com/user/project-gallery/64
Wooden Clock Face
Putting my clock face design on paper and fitting the dimensions i wanted to use for a wall clock. This was after I had revised the dimensions severally. My initial idea was that i have one big ring and four small circle. On each small clock i would attach the clock hands at 12,3,6and 9. Thus I would have a total of 13 parts to assemble together.

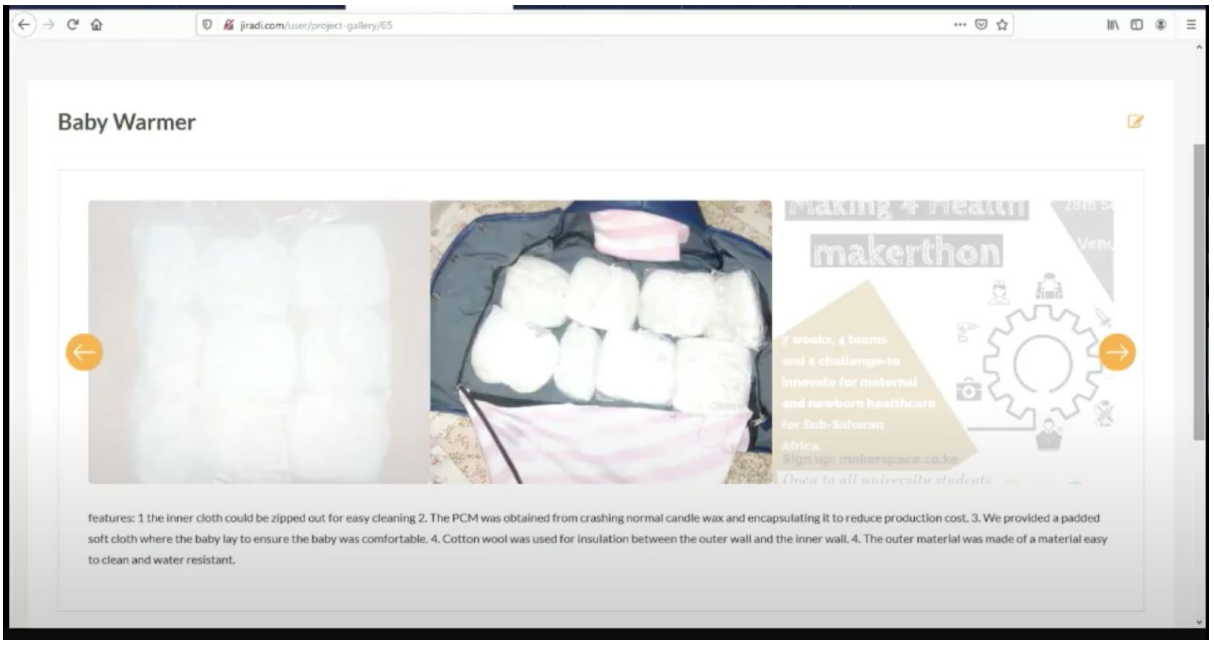

jiradi.com/user/project-gallery/64
Wooden Clock Face
Fabrication involved using a CNC machine called Shop bot. The first step was to save the solid works design as a PDF. Next was transferring the file to a computer integrated with the shop bot machine. This computer had part-works software and the shop bot software. Next was securing the piece of MDF (Medium Density Fiber Board) on the shop bot working table using G-Clamps. Next was running our design in part-works.

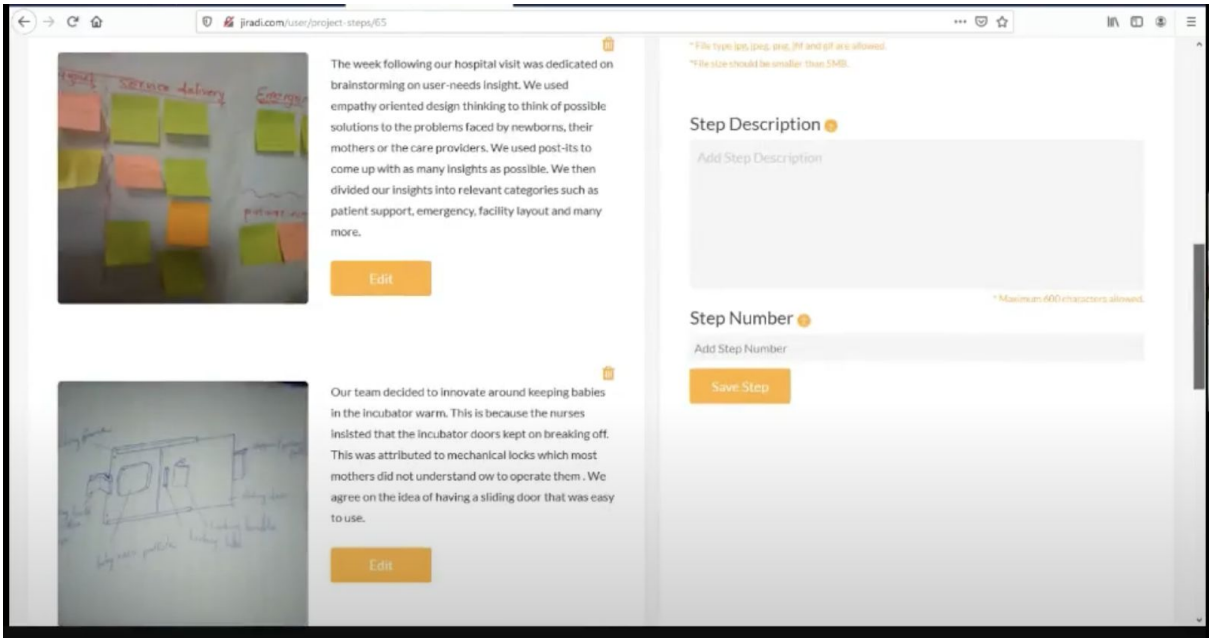

jiradi.com/user/project-gallery/64
Wooden Clock Face
Due to the use of MDF exposure of underlying layers made the design had rough edges. A sand paper was used to smooth-en the design. reaching the inner corners was a little bit challenging.The next step includes designing the gear system of the clock hands . The idea is to have it 3d printed. Ten my clock will be ready to go up a wall.

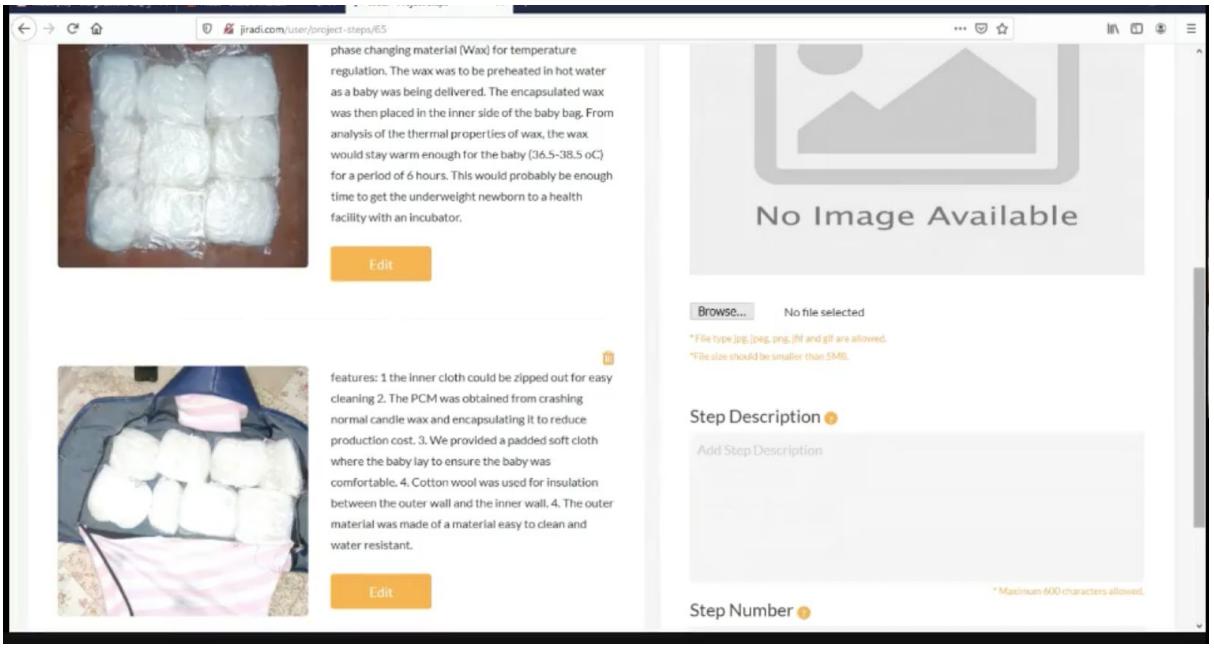

jiradi.com/user/project-steps/64
Preview Project
Save All Changes
Design
Fabrication
Polishing
Wooden Clock Face
A simple project aimed at learning about computer aided design
Putting my clock face design on paper and fitting the dimensions i wanted to use for a wall clock. This was after I had revised the dimensions severally. My initial idea was that i have one big ring and four small circle. On each small clock I would attach the clock hands at 12,3,6and 9. Thus I would have a total of 13 parts to assemble together.
Edit
Add New Step
No Image Available


jiradi.com/user/project-gallery/65
Baby Warmer
Making for health
makerthon
Service delivery
Making for health Makerthon was aimed at innovating on maternal and newborn health in order to lower mortality rate in Kenya, Africa. The seven wee innovation process started with a field study visit to Kenyatta National Hospital in Nairobi. We visited the newborn and maternal unit, interacted with the care providers and made observations on how things were run.


jiradi.com/user/project-gallery/65
Baby Warmer
We never saw our design taking a shift from slide to open door to a baby warmer bag. We had three design ideas around having babies from hypothermia; sliding incubator doors, baby warmers bag and using solar energy. When we involved other participants from other teams to vote for the idea they thought was the most viable, the baby warmer bag won.


jiradi.com/user/project-gallery/65
Baby Warmer
makerthon
features: 1 the inner cloth could be zipped out for easy cleaning 2. The PCM was obtained from crashing normal candle wax and encapsulating it to reduce production cost. 3. We provided a padded soft cloth where the baby lay to ensure the baby was comfortable. 4. Cotton wool was used for insulation between the outer wall and the inner wall. 4. The outer material was made of a material easy to clean and water resistant.


jiradi.com/user/project-steps/65
The week following our hospital visit was dedicated on brainstorming on user-needs insight. We used empathy oriented design thinking to think of possible solutions to the problems faced by newborns, their mothers or the care providers. We used post-its to come up with as many insights as possible. We then divided our insights into relevant categories such as patient support, emergency, facility layout and many more.
Edit
Our team decided to innovate around keeping babies in the incubator warm. This is because the nurses insisted that the incubator doors kept on breaking off. This was attributed to mechanical locks which most mothers did not understand ow to operate them . We agree on the idea of having a sliding door that was easy to use.
Edit
Step Description
Add Step Description
Step Number
Add Step Number
Save Step


jiradi.com/user/project-steps/65
phase changing material (Wax) for temperature regulation. The wax was to be preheated in hot water as a baby was being delivered. The encapsulated wax was then placed in the inner side of the baby bag. From analysis of the thermal properties of wax, the wax would stay warm enough for the baby (36.5-38.5 oC) for a period of 6 hours. This would probably be enough time to get the underweight newborn to a health facility with an incubator.
Edit
No Image Available
Browse...
No file selected
*File type jpg, jpeg, png, jfif and gif are allowed.
*File size should be smaller than 5MB.
features: 1 the inner cloth could be zipped out for easy cleaning 2. The PCM was obtained from crashing normal candle wax and encapsulating it to reduce production cost. 3. We provided a padded soft cloth where the baby lay to ensure the baby was comfortable. 4. Cotton wool was used for insulation between the outer wall and the inner wall. 4. The outer material was made of a material easy to clean and water resistant.
Edit
Step Description
Add Step Description
* Maximum 600 characters allowed.
Step Number

References

African Development Bank. (2016). Jobs for Youth in Africa: Catalyzing youth opportunity across Africa. Retrieved November 14, 2019, from https://www.afdb.org/fileadmin/uploads/afdb/Images/ high_5s/Job_youth_Africa_Job_youth_Africa.pdf

Ash, L.E. (2000). Electronic Student Portfolios. K-College.

Behance. (2017). Year in Review. Retrieved April 5, 2020, from https://www.behance.net/Yearinreview

Brennan, K. (2012). Best of both worlds: Issues of structure and agency in computational creation, in and out of school. Doctoral dissertation, Massachusetts Institute of Technology.

Coban, A. (2019, May 19). Calculative Making: The Fear of Failure in Kenya's Makerspaces. Society for Social Studies of Science. https://www.4sonline.org/blog/post/calculative_making

Cooper, A. (2004). The Inmates Are Running the Asylum: Why High Tech Products Drive Us Crazy and How to Restore the Sanity (2nd Edition).

Dalsgaard, P., & Halskov, K. (2012). Reflective Design Documentation. Retrieved April 5, 2020, from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.473.2655&rep=rep1&type=pdf

Deloitte. (2019). Global Mobile Consumer Survey: The Kenyan Cut. Retrieved April 6, 2020, from https://www2.deloitte.com/content/dam/Deloitte/ke/Documents/technology-media-telecommunications/Deloitte_GMCS_Report_The_Kenyan_Cut_August_2019.pdf

Dewey, J. (1933). How We Think, New York: D. C. Heath.

Ecosystem Accelerator. (2016). A few things we learned about tech hubs in Africa and Asia. Retrieved April 5, 2020, from https://www.gsma.com/mobilefordevelopment/programme/ecosystem-accelerator/things-learned-tech-hubs-africa-asia/

Fessenden, T. (2018, April 15). Scrolling and Attention. Nielsen Norman Group. https://www.nngroup.com/articles/scrolling-and-attention/

Kolb, D. A. (1984). Experiential learning: Experience as a source of learning and development.

Leahy, L.R., & Filiatrault, A. (2017). Employers' Perceptions of the Benefits of Employment Electronic Portfolios. Retrieved April 5, 2020, from http://www.theijep.com/pdf/IJEP271.pdf

Maina, S. J. M. (1984). Traditional African Graphic Design in Kenya (Form Content Appreciation and Communication). Bachelor's Thesis. University of Nairobi.

Maker Education Initiative. (2016). Practical Guide to Open Portfolios. Retrieved November 14, 2019, from https://makered.org/wp-content/uploads/2016/11/Maker-Ed-OPP-A-Practical-Guide-to-Open-Portfolios_final.pdf

Maker Education Initiative. (n.d.). Survey of Makerspaces, part III. Retrieved November 14, 2019, from http://makered.org/wp-content/uploads/2016/01/MakerEdOPP_RB8_Survey-of-Makerspaces-3_final.pdf.

Mavhunga, C.C. (2017). What Do Science, Technology, and Innovation Mean from Africa?

Odongo, A., & Rono, G. (2016). Kenya Digital and Cultural Divide. Retrieved April 5, 2020, from https://www.researchgate.net/publication/303704670_Kenya_Digital_and_Cultural_Divide

Resnick, M. (2007). All I Really Need to Know (About Creative Thinking) I Learned (by Studying How Children Learn) in Kindergarten. In Proceedings of the 6th ACM SIGCHI Conference on Creativity & Cognition (pp. 1–6). New York, NY, USA

Resnick, M., & Robinson, K. (2017). Lifelong kindergarten: Cultivating creativity through projects, passion, peers, and play. The MIT Press.

Schön, D. A. (1983). The Reflective Practitioner: How Professionals Think in Action.

Tseng, T. (2016). Making Make-throughs: Documentation as stories of design process. Doctoral Dissertation. Massachusetts Institute of Technology.

Papert, S. (2000). The children's machine: Rethinking school in the age of the computer. BasicBooks.

Papert, S. (1980). Mindstorms: Children, Computers, and Powerful Ideas.

Woodbury, D., Addams, L., & Neal, W. (2009). The Career Portfolio:A Practical Job SearchTool. Retrieved November 14, 2019, from https://clutejournals.com/index.php/TLC/article/view/1148/1132