Forest Printer Monitoring System

Venture Proposal

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1. Executive Summary

Forest is a cloud-based program to help businesses, schools, and other organizations quickly and easily manage printers on their local network by collecting detailed usage statistics and compiling them into functional and targeted graphs and diagrams. Forest can help organizations analyze their environmental impact by displaying paper and toner usage, but perhaps more insightfully, compare usage across the entire network, giving insight to which printers are used most frequently and which may be unnecessary to replace when the time comes. Unlike its competitors, Forest aggregates data continuously in the cloud. This allows customers instant access to their data regardless of location.

Forest works by having the client install a small program on any computer that will remain running on their local network. If there is no suitable device, we plan to release a small, self-contained device that will be connected to the network and perform the necessary querying by itself. At a customizable time interval, the software will determine which printers on the network have been added to Forest and query each one for its status, which is sent back to the cloud. Data instantly becomes available on the Forest console.

Rather than just report data to a screen, Forest provides real-time alerting via email, SMS, and down the road, mobile apps. This enables IT to respond quickly to incidents and minimize the disruption in productivity by using predictive analysis to estimate ideal times to perform maintenance tasks such as replacing toner and adding paper. Notifications can also be configured to alert staff to paper jams and other emergencies.

Another great feature of Forest is its ability to be used not only by IT, but by anyone in the organization. Administrators have the ability to specify how much, if any, of the information about their printers is available publicly. We will offer embeddable widgets to display the current status of any printer, provide a network overview suitable for embedding, and even have a display where users can submit a problem report to IT if they encounter a printing problem Forest hasn't already picked up. These embeddable components help IT to become more engaged and responsive. With Forest's advanced access-control, there is no need to worry about data being accessed by the wrong people. With fully customizable options including unlimited, authentication-based, IP whitelisting, or completely private and sealed off, we can work with organizations to provide the features they need. Forest is a complete printing management solution that will help organizations increase productivity while decreasing costs and environmental impact.

2. Overview

2.1. Introduction

Forest is a simple printer management system designed to meet client needs in a with a simple, intuitive, and powerful interface. With Forest, it is easy to configure monitoring of all the printers on your network. Using it is as simple as creating an account for your organization, adding the IP addresses of your printers to the web console, and downloading and installing a tiny piece of software that needs to be run on the same LAN as your printers. You will immediately begin to see the current status of all of your printers at a network-wide level, including problem areas with low supplies and unreachable network addresses. Forest also allows you to zoom in and get detailed statistics on current supply levels of any printer, which are charted over time, allowing staff to determine which printers are used most and least frequently and to better predict usage to help with supply ordering, future hardware purchases, and maintenance.

2.2. Abbreviations and Definitions

- API – Application Programming Interface – the set of methods and actions that can be performed on the objects (organizations, users, printers, statuses) in the Forest system
- Heroku – a cloud hosting platform for web-based applications; will be used to store the database and the code to implement the API
- Ruby Gem – a custom built module for Ruby which can be installed in a single command using the gem command line tool and rubygems.org
- SNMP – Simple Network Management Protocol – the protocol used to contact the printers on the local network; allows the query program to access page count, cartridge levels, and statuses of the printers.
- IP — Internet Protocol. The underlying protocol used to communicate over the Internet.
- LAN — Local Area Network. A branch of the Internet that is self-contained, such as your company or school network.

3. Market Analysis

3.1. Needs Analysis

- Education
  - Printing is a vital resource for educational systems, whether it be printing a project, paper or presentation. Printer maintenance for departments or schools of 1,000 people can reach upwards of $3000 per month. The productivity of the classroom depends on the condition of the printer. For IT departments, knowing when printers need servicing is the key to preserving this flow. With Forest, IT staff can be alerted of a printer problem and fix it before faculty or students have even reported it.
  - Case: Muhlenberg College, Allentown, Pennsylvania
    - Over 50 printers working on campus
    - Printer cost: $800 each
    - Toner cost: $150 per cartridge
    - Maintenance cost: ~$25 per printer per month
    - Total cost per year: $150,000
  - With Forest, IT departments can keep track of printer's needs, discouraging untrained personnel from trying to self-diagnose and potentially breaking the device. It would also ensure a constant flow of paper, eliminating backed up printer queuing, which normally cause multiple printouts to be wasted.
- Business/Other
  - Other medium to large organizations with many printers can use Forest. These organizations could include businesses and libraries. The approximate size of these markets is about 575,000 medium to large businesses and about 9,000 public libraries. These markets would have approximately the same cost per printer and cartridge as the education market but they might have less printers depending on the size of the organization.

3.2. Competitive Analysis

- Accurate Printer Monitor
  - Aimed at medium to large businesses who want to monitor and account for individual employee printing; supports only Windows and may not use current technologies since all OS versions back to Windows 2000 are supported.
- HP Web Jetadmin
  - Aimed towards large enterprises with a large dedicated IT department. This software focuses on businesses running only HP devices. It can be accessible on multiple Windows computers, with one main admin computer hub.
- Print Manager
  - Displays print traffic and managing reports; mainly monitors individual account printing activity for payment purposes.

- PaperCut
  - A web-based printer administration console with reports on each printer's usage as well as billing information and per-user quotas. A major difference here is that PaperCut is downloaded and installed on a server on the local network, while Forest works in the cloud to dramatically reduce IT infrastructure requirements.

Feature or Characteristic	Forest	Accurate Printer Monitor	HP Web Jetadmin	Print Manager	PaperCut
Web Interface	Yes	No	No	Yes (with add-on)	Yes
Centralized Data	Yes	Yes	Yes	Yes	Yes
Printer Use Graphs	Yes	Yes	Yes (with add-on)	Yes	Yes
Ability to Monitor Other Technology	Proposed	Limited (copiers as well)	Limited (HP devices)	No	No
Possibility of Multiple Client Interfaces	Yes	No (just Windows desktop)	No (just Windows desktop)	Yes (depending on edition purchased)	No
Simple to Use	Yes	No	No, training	Claimed	Claimed
Automated Monitoring	Yes	Yes	Yes	Yes	Yes
Uses Current Technologies	Yes	Unknown (supports Windows 2000 – 8)	Somewhat (some features not supported by newer Windows systems)	Yes	Yes
Automatic Updates	Yes	No	No	No	No
Print Job Control	No	No	No	Yes	Yes
Exportable Reports	No	Yes	Yes	Yes	Yes
User Reporting of Printer Problems	Yes	Yes	No	No	Yes
Scalable Pricing Scheme	Yes	No	No (free)	Yes	Yes (User-based)

4. Requirements

4.1. Actors & Use Cases

The Forest system can be used by any organization that needs to keep track of a large number of printers; this may include colleges/universities, companies, libraries, and other groups. All users of Forest will be able to view the product demo to get a general overview of what the product does.

The Forest API and database information will be accessed through a web interface or, in the future, native desktop clients and mobile applications. Outside of the web server, the only other program which will be able to access the API is the query program that will be installed on each client organization's local network to monitor printer activity.

Specific Users of Forest include:

- Unregistered Users – An unregistered user is any user without a Forest account. They will be able to register for an account or request an account for their organization.
- Registered Users – A registered user is a normal user who has a non-administrative role with Forest. They will be able to view printer statuses, edit their user information, and report errors with a particular printer. A registered user may be a worker in the IT department of a company who has to view printer information in order to change paper or toner when they are low.
- Organization Admin Users – An admin user will be able to do everything a registered user can as well as more managerial tasks. They can edit their organization (name and other properties), create and modify users, create and modify printers. The organization admin could be the head of the IT department who decides which printers can be monitored and knows the users that will be part of the organization.
- Product Admins – Product administrators will have the power to create and edit organizations and also users and printers when needed.

Use Case	Unregistered User	Registered User	Organization Admin User	Product Admin
View Product Demo	X	X	X	X
Register for an Account	X			
Request an Organization Account	X			
Create Organizations				X
Edit Organizations			X[1]	X
Delete Organizations				X
Log into Client Application		X	X	
View Printer Status		X	X	
View Printer Status Graphs		X	X	
Add Users			X	X
Edit Users		X[2]	X	X
Delete Users			X	X
List an Organization's Users			X	X
Add Printers			X	X
Edit Printers			X	X
Delete Printers			X	X
Report Printer Error	X	X	X	

[1] – Product Admins can modify any organization but organization admins can only change their own organization.

[2] – Non-admin Registered Users can only modify their own information; Admin Users can modify any user's information.

4.2. Requirements

Category	Requirement	Priority	Phase	Cost
Hardware	Server or Computer to install query program on (needs to run continuously to provide constant monitoring)	High	Installation (User side)	May be preexisting
	Internet-enabled device (to access Forest website)	High	Installation (User side)	Preexisting
	Printers that support SNMP	High	Installation, Use	Preexisting or up to $800
Software	Current browser that supports HTML5, CSS3, and JavaScript (Chrome 20+, Opera 9+, Internet Explorer 9+, Safari 3.1+, Firefox 15+)	High	Installation (User side)	Preexisting or Free
	Computer or Server which supports Ruby (for query program)	High	Installation, Use	Preexisting or Free
	Website Server that supports PHP	High	Development, Use	Preexisting – Heroku
Networking	Internet access (Developers and users should be able to connect to internet to use the website)	High	Development, Installation, Use	Preexisting
	Printers should be connected to the same local network	High	Installation/Use	Most likely preexisting
Concurrency	Multiple Users should be able to access the system at the same time	High	Use	Ability to handle more users will scale with use
Data Storage	Store printer status data securely in the cloud	High	Development, Use	Scalable Database (included in Heroku scaling)
Internationalization	Support English localization	High	Development, Use	
	Include other common languages	Low	After initial release	
Error Handling	Duplicate Users and Organizations should not exist	High	Development, Use	Included in API and database structure
	Protect database and API from changes outside of authorized client applications	High	Development, Use	
Security	User Authentication	Medium	Development, Use	Included in API
	API Authorization (ensure that only client access is allowed)	High	Pre-release	
	User Roles (admin vs. non-admin)	Medium	Development	
	Password Encryption	High	Development, Use	Included in API
	Users should only be able to view information about their own organization	High	Development, Use	
Testing	API Tests	High	Development	
Documentation	Demo Video	Low	After Initial Release	
	Installation Guide	Medium	Pre-release	

Category	Requirement	Priority	Phase	Cost
Documentation	Usage instructions/Frequently Asked Questions	Medium	Pre-release	
	API Structure matches what is documented	High	Development	
Installation	Self-contained installer for query program	High	Development	
	Self-contained query device for monitoring printers	Medium	After initial release	$30 - $60 for Arduino board
Performance/ Functional	Ability to manage user account information (email, password, etc.)	Medium	Development, Use	
	Unregistered users can report printer problems (on Forest website or separate script)	High	Development, Use	
	Manage printers and users as an administrator	High	Development, Use	
	Automatic emails of printer reports and alerts (customizable setting)	Medium	Development, Use	
	Retrieve/reset password when forgotten	Medium	Development, Use	
	Automatic printer querying with customizable query interval	High	Development, Use	
	Expanded range of charts and history graphs	High	Development, Use	

Blank cells in 'Cost' column represent little to no cost outside of normal developer salary or features included in API code for no additional cost.

4.3. Deliverables

The deliverables for the initial release of Forest include:

- Web interface for viewing printer statuses
- Query Program installer (Ruby gem)
- Default admin login for each organization registered
- Email/password combination for each user registered or created

Deliverables for future planned releases include:

- iPhone/iPad and Android mobile app
- Advanced notifications
- Advanced statistics and predictive algorithms
- Embeddable widgets
- Self-contained query agent device to be sold to clients for a $100 one-time fee.

5. Design

5.1. User Interfaces

- Users will first be navigated to the login screen (Fig. 1) where they can either sign in or create a new account.
- Users can create an account by entering in the information into the registration page (Fig. 2). Users must be affiliated with an organization. Organizations can be created by contacting Forest.
- Once logged in, users will encounter the main screen (Fig. 3) occupied by a table containing the organizations' registered printers. The table can be sorted (ascending/descending) by clicking on the headings in the top row.
- Clicking the icon in the right most column of a printer will produce a pop up screen containing various graphs reporting on trends such as paper/toner usage and status history (Fig. 4).
- Admin users can add printers by hovering over "Add" then clicking "Printer" in the navigation bar, directing them to a form (Fig. 5). The user must provide at least the organization and IP address of the printer in order for Forest to locate and extract the specific printers information. The user also has the ability to manually override printer information such as location.
- Users also have the ability to report printer issues by clicking on "Report" in the navigation bar (Fig. 6). In the future, this page will be accessible to anyone without an account. Submitting the form will send it to Forest admins and show up as an alert in the table under the specific printer.

5.2. Design Diagrams

The main components of the product which interact are the database, API, query program, and the client applications. The data in the database is accessed through the API by sending HTTPS requests on different actions. The query program resides on the client organization's local network and regularly queries the printers for information about status, consumables, and page count; this information is then pushed to the database so it can be used by client applications. Client applications will be authorized to access the API; potential client applications include the current web interface, native desktop applications, and mobile applications. The interaction diagram for Forest as seen in Figure 7.

5.3. Other

- 3rd Party Components:
  - Node.js, ActionHero.js, Mongoose (MongoDB) – the backbone structure of the API to handle HTTP requests
  - Mocha, Should – Developer side testing tools that integrate with Node.js

6. Project Plan

6.1. Team and Organization

The Forest team currently consists of Mike Borowsky, Macauley Breault, Ben Burwell, and Andrew Trautmann. We work closely together and collaborate on various tasks. Generally, Andrew and Ben are working on back-end services including the API and query agent, while Macauley does front-end design and development and Mike works on API integration.

The process is collaborative; we generally work together in one room with a big whiteboard to plan and diagram out ideas. We emphasize rapid prototyping and flexible microteams to work together on tasks. Our management strategy is detailed in our Code of Conduct, which all members of the team must sign and adhere to. The Code outlines procedures to be followed in case of disputes, failure to meet expectations, and other such situations.

For version control and project management, we use GitHub with several repositories for various aspects of the project, including the Node.js application that powers the API, one for the PHP/HTML/CSS/JavaScript used to create the web front-end, one for the query agent, and another repository for document and diagrams. Eventually, we would like to start a paid GitHub account in order to keep our backend code private. The cost of this service and how it fits into our budget is described in a later section of this document.

6.2. Estimates & Schedule

We would like to continue work on this project and have an initial release within one month. To do this, we need to finalize the implementation of the Query Agent, create a unified front-end user experience and create usage paths, and further develop the data collection and analysis to track additional data points, such as performing usage calculations based on page count.

Additionally, we need to develop documentation and marketing materials to distribute to potential clients. This would include a video or interactive tour demonstrating the various features of Forest to drive clients to sign up for a free trial month, and documentation regarding our features and how to configure the various options for existing customers. Figure 8 shows a Gantt chart for the project.

6.3. Resource & Budget Requirements

Due to our use of the Heroku cloud application hosting platform, there was no initial investment to get the project started. A free account on Heroku allowed us to start developing the API and database structure without worrying about purchasing and setting up a server. As we get more clients for our system and the number of API calls per day increases, we will be able to add more server power to our project and increase the capacity of our database using Heroku's tiered pricing scheme. Also, if usage drops, we are able to decrease the cost of the server. Beyond the server, we are using software systems that are open source or free to use; therefore, there is no cost for development other than hardware to code and test on (most of which is preexisting.

Our main source of revenue will be licensing our product to various organizations. We have decided on a sliding scale of pricing starting at $1 per printer per month; the more printers an organization has, the less they will pay per printer per month. Once we start to get some users of Forest, we will begin marketing our products using testimonials from current users; most of the marketing will be going to organizations, showing them the product, and trying to sell it to them. Marketing would also include having a demo video on the website to explain the product and why it is different from other systems. Once we start making revenue, we will focus our spending on software development so we can continue to innovate and provide a simple, useful product. To see a rough estimate of the budget for the first year of Forest, please see the Forest Estimates pdf file.

6.4. Risks

Category	Risk	Probability	Impact	Response
Hardware	Printers incompatible with SNMP	Low	High	We would need to develop some other way to query the printer status, perhaps using IPP or another protocol.
Hardware	Manufacturer differences in SNMP data	Medium	Medium	Have several redundant strategies to query for specific data points
Software	Hackers ability to modify database data	Medium	High	Create secure systems, keep backups, perform audits of server logs and deltas.
Hardware	API/Database Server goes down	Low	High	Have backup servers and work-arounds for this case
Hardware/ Software	Update in printer protocol and software for registered printers	Low	Medium	Quickly adapt to changing specifications and create new query program installer
Software	Query program not updated to match API structure	Medium	High	Add auto-updating capabilities or notifications of new versions of the program
Software	Use up database storage on API server	Medium	High	Keep a close eye on usage of the database and upgrade storage size before it becomes a problem

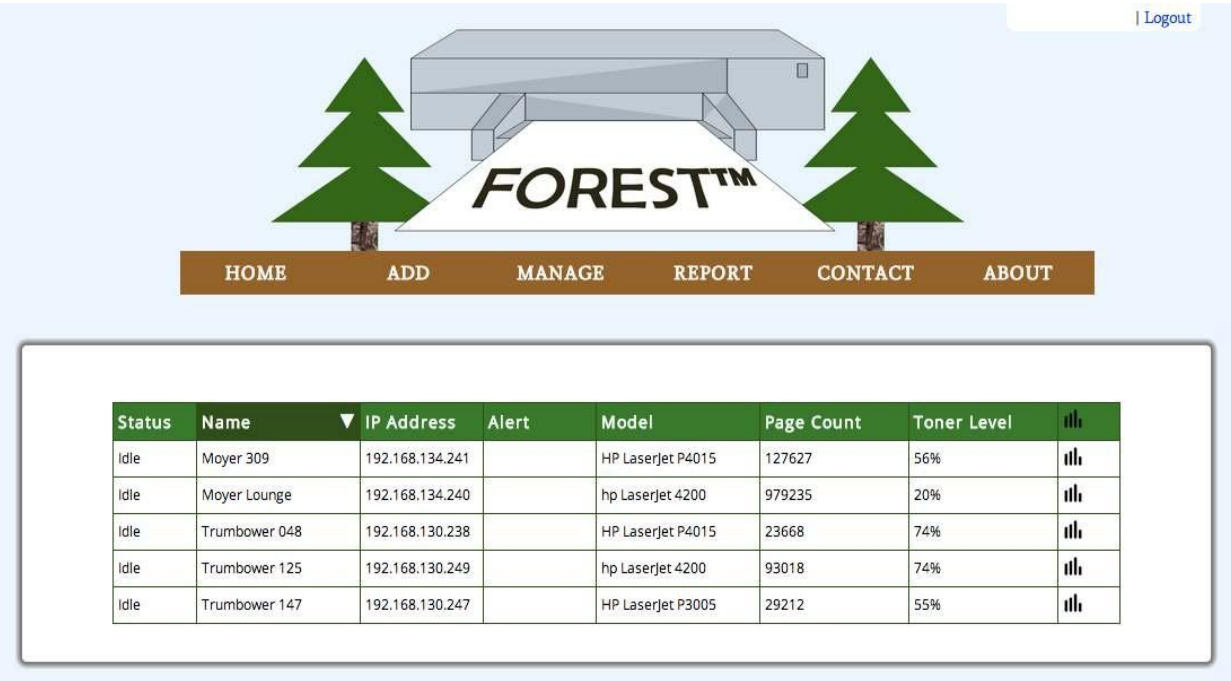
7. References

- http://www.census.gov/econ/susb/ - US Census data for number and sizes of US businesses
- http://www.census.gov/compendia/statab/2012/tables/12s1153.pdf – US Census data on US public libraries
- http://nces.ed.gov/fastfacts/display.asp?id=84 – Information on the number of Higher Education institutions in the US
- http://www.softwareshelf.com/HTML/products/prod_materials/23/PMP_Academic_Story.pdf – Report on printer use in the education system
- http://www.morrisanderson.com/images/uploads/documents/32311_Printing_in_the_US_industry_report.pdf – information about the commercial printing industry
- http://www.caniuse.com – A reference to determine which web browsers can be used for the system.
- http://www.aggsoft.com/printer-monitor.htm – Accurate Printer Monitor product page
- http://h20331.www2.hp.com/hpsub/cache/332262-0-0-225-121.html – HP Web Jetadmin product page
- http://www.printmanager.com/products/ - Print Manager product page
- http://www.papercut.com/ - PaperCut product page

8. Figures

Figure 1: Login Page.

Figure 2: User Registration Page



Status	Name ▼	IP Address	Alert	Model	Page Count	Toner Level	
Idle	Moyer 309	192.168.134.241		HP LaserJet P4015	127627	56%	
Idle	Moyer Lounge	192.168.134.240		hp LaserJet 4200	979235	20%	
Idle	Trumbower 048	192.168.130.238		HP LaserJet P4015	23668	74%	
Idle	Trumbower 125	192.168.130.249		hp LaserJet 4200	93018	74%	
Idle	Trumbower 147	192.168.130.247		HP LaserJet P3005	29212	55%	

Figure 3: Main Page with Printer Table

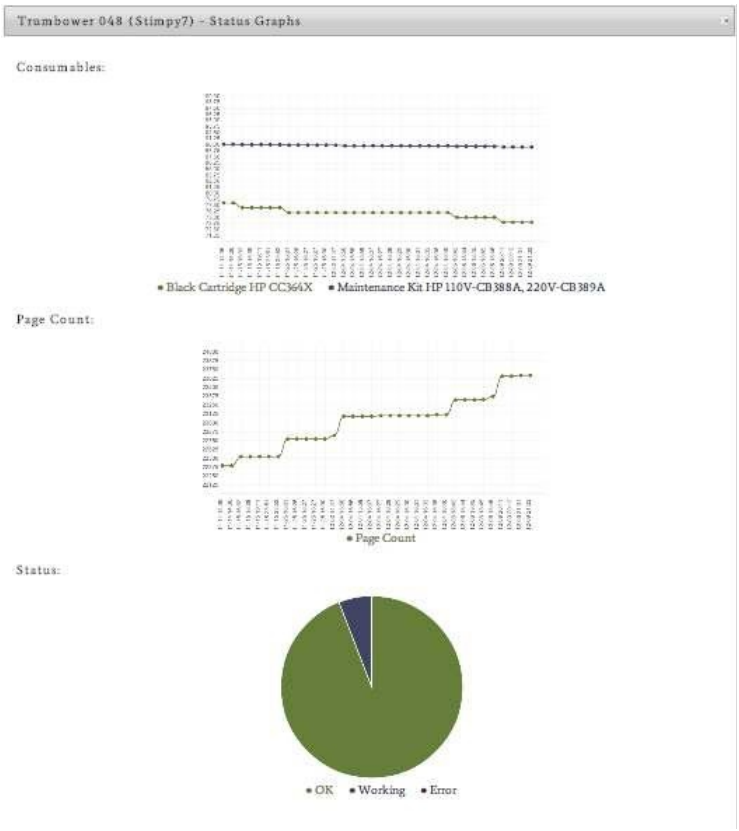


Figure 4: Graphs based on Printer Data

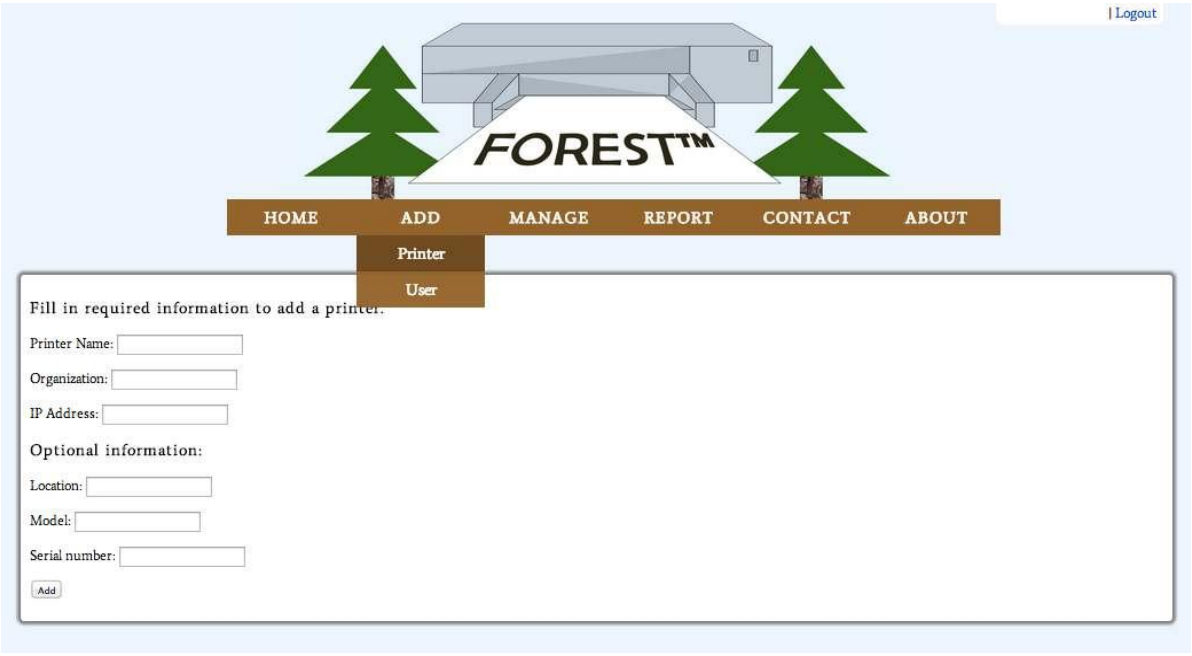


Figure 5: Form to Add Printer

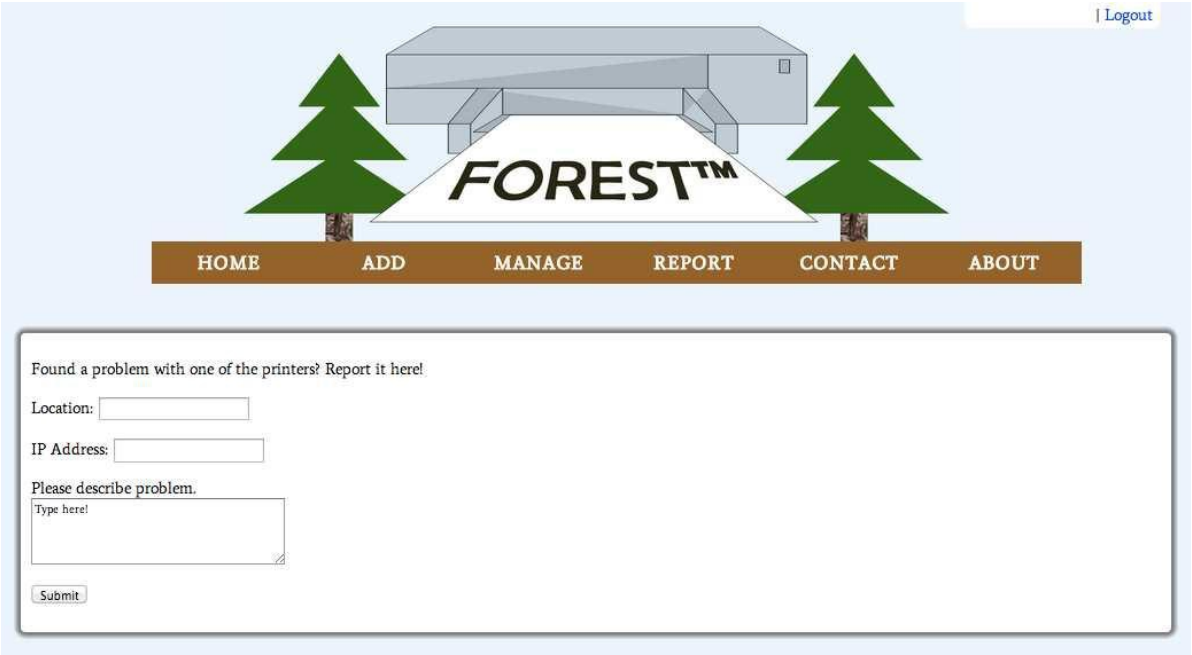


Figure 6: Reporting Form

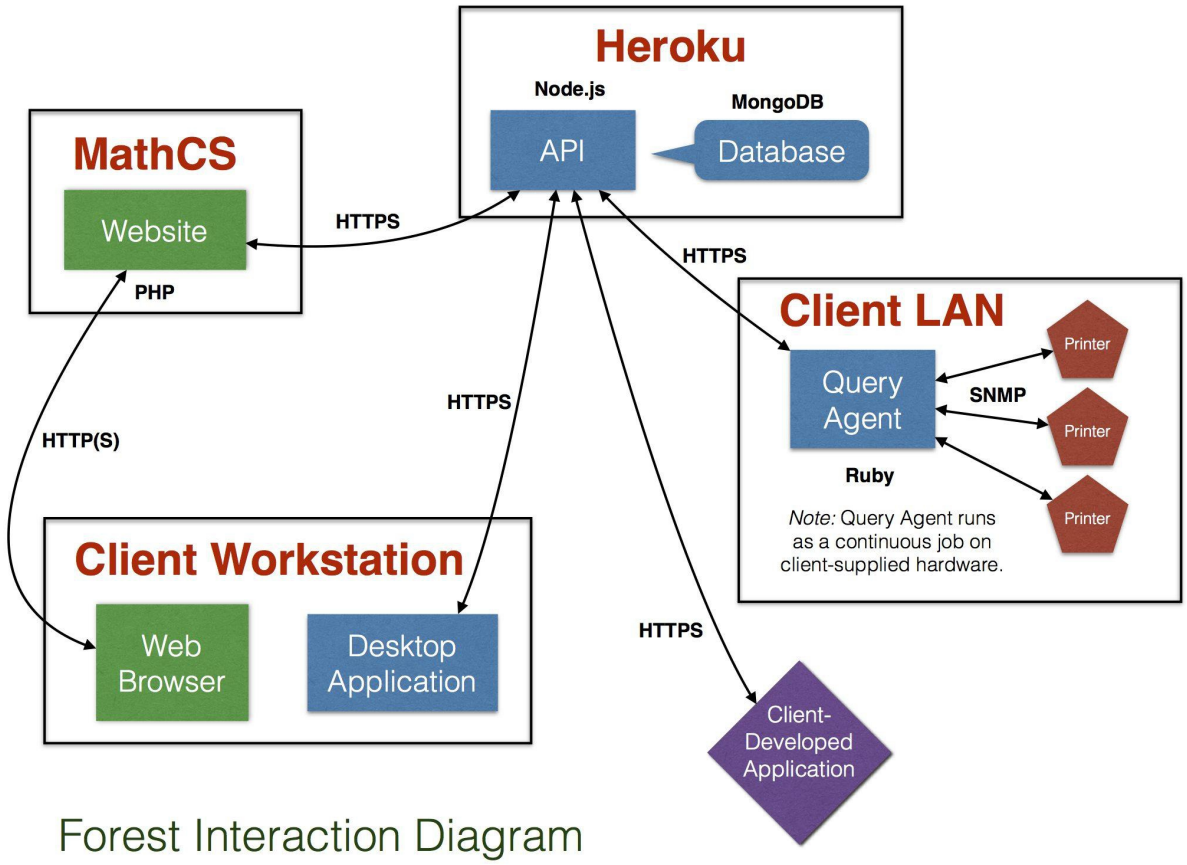


Figure 7: Interaction Diagram

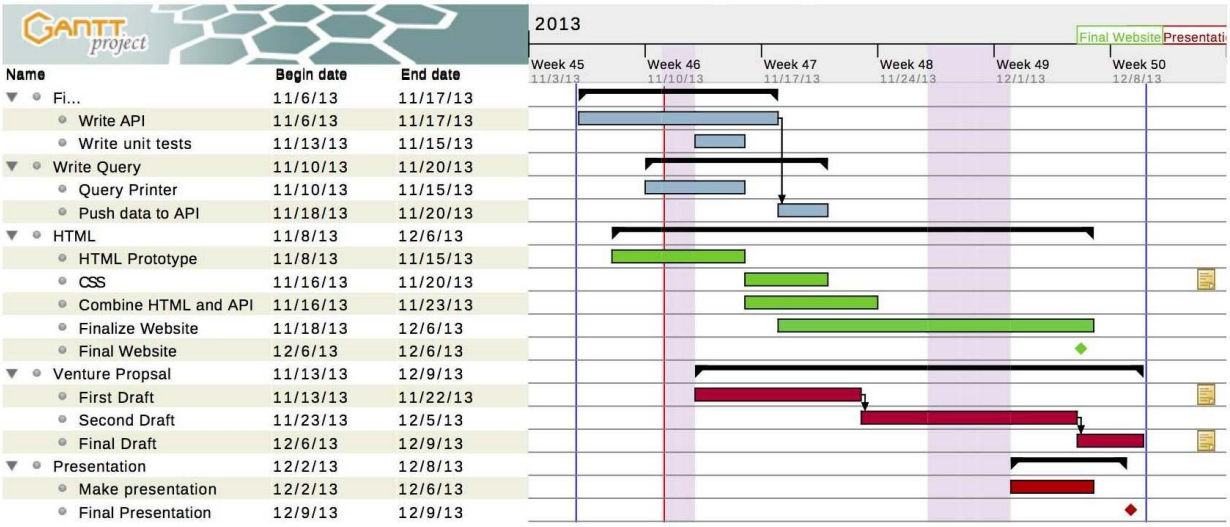


Figure 8: Gantt Chart