USB Drive Storage Reader

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Abstract

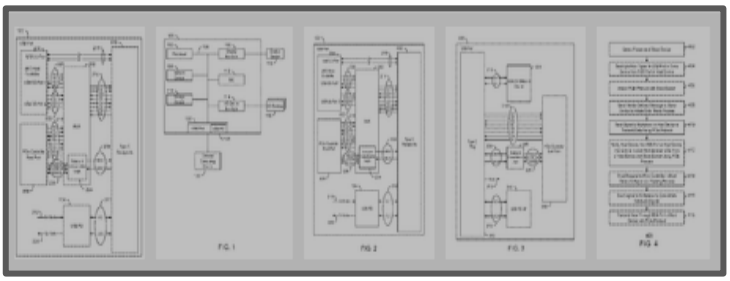
This project discusses the difficulty of trying to figure out how much storage a USB drive contains. This design brief will go over the specifics of the problem, a justification for why it is a problem, previous and existing solutions to this problem, and what path(s) can be taken to solve it as we go through the design process to develop a solution.

Problem Statement

USB drives are a convenient way to store digital files. However, when in a hurry, a full USB drive or other storage device can be a real hindrance in trying to transfer files as there is no space in the drive. The only way to find the amount of storage left in a USB drive currently is to plug it into a computer, which can be a hassle, especially in a hurry.

Existing Solutions

Patent : 7462044
USB flash drive memory capacities now reaching 64GB and higher, we incorporated a biometric fingerprint scanner function into the design of our new Patented Retractable USB flash drive, while keeping with the popular theme of our signature retractable USB connector.



Patent : US9952986B2
Techniques for transmitted data through a USB port using a PCIe protocol are described herein. It has techniques for both USB power consumption as well as for data transmission.

Problem Validity

A survey was conducted to justify this problem by assessing interest in a solution to this problem and to learn more about our potential market. There are currently 43 respondents.

- **90.7%** of respondents own/use USB drives
- **23.3%** of respondents use USB drives very often
    - **9.3%** use them often
    - **16.3%** use them moderately
- **53.5%** of respondents find figuring out how much storage a USB drive has to be time consuming/difficult
- **58.1%** of respondents find not knowing how much storage a USB drive has to be a problem
- **32.6%** of respondents are really interested in seeing a solution
    - **23.3%** would be interested

Solution Statement

Design a system that, when a USB flash drive or other form of USB storage device is plugged in, can provide the total and remaining storage space in the drive while ensuring that the system doesn't in any way affect the drive that is being plugged in.

Criteria

- Quickly provide storage information about the USB drive by simply plugging in
- Be able to display the storage information of multiple USB storage devices at once
- Must be easy for anyone to use and provide information is a clean and intuitive way
- Product must be quicker than existing methods to find out the remaining space in a drive

Constraints

- **Money** - *The product must be affordable and reasonably priced*
- **Time** - *The product must be completed within our timeline*
- **Effectiveness** - *The product must not corrupt, alter, or damage the contents of the drive in any way*

Sources

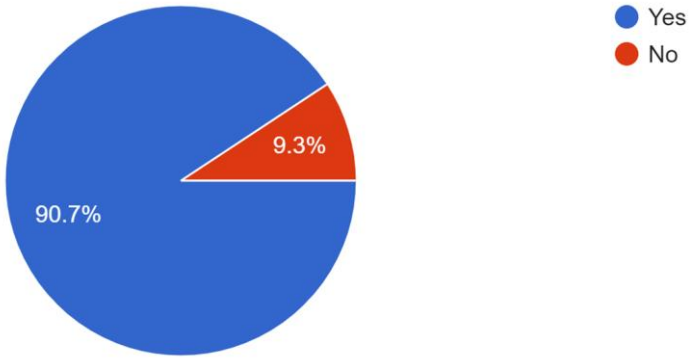
Pethe, A. G. (2014). U.S. Patent No. US9952986B2. Washington, DC: U.S. Patent and Trademark Office.

Direct, E. (2009). U.S. Patent No. US7462044. Washington, DC: U.S. Patent and Trademark Office.

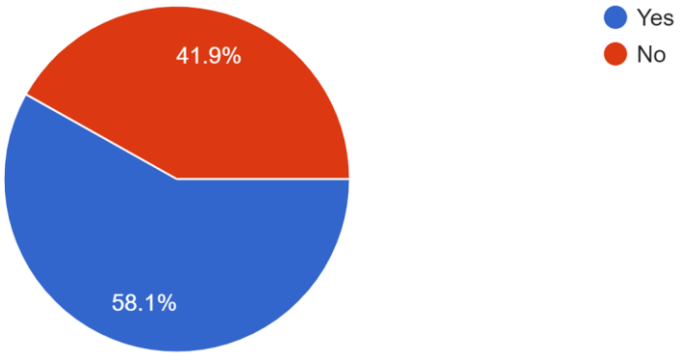
Validation

An anonymous survey was sent out to verify the validity of this and related problems. The survey currently has 43 respondents.

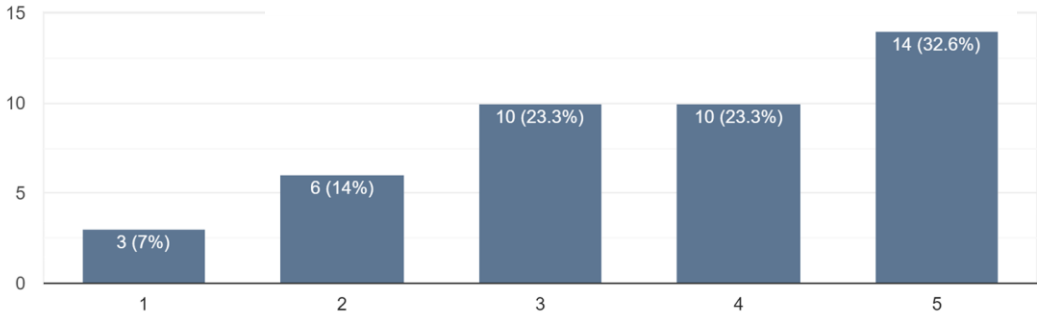
Do you own/use any USB drives?

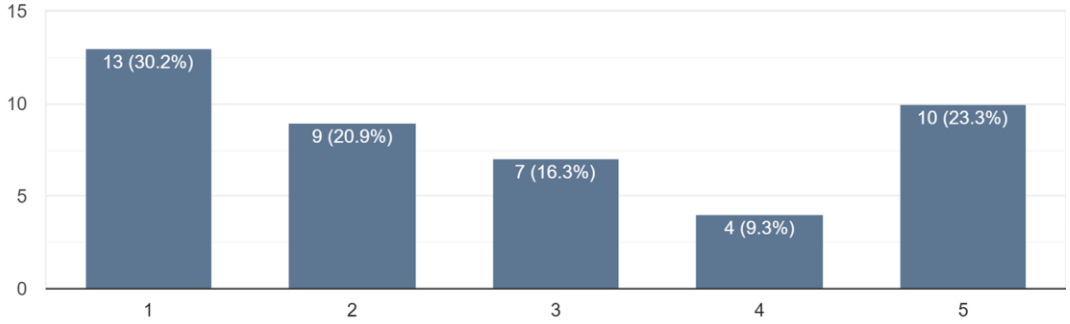


Does not knowing how much storage a USB drive ever become a problem?



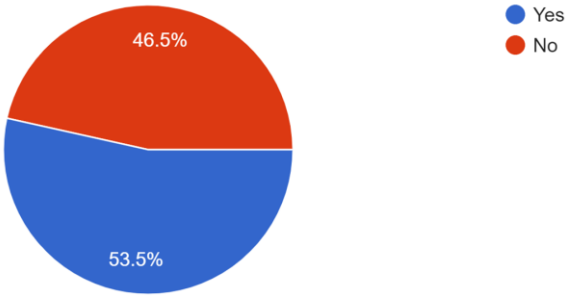
How interested would you be in seeing a device that can quickly and easily tell you the remaining storage on a USB flash drive?





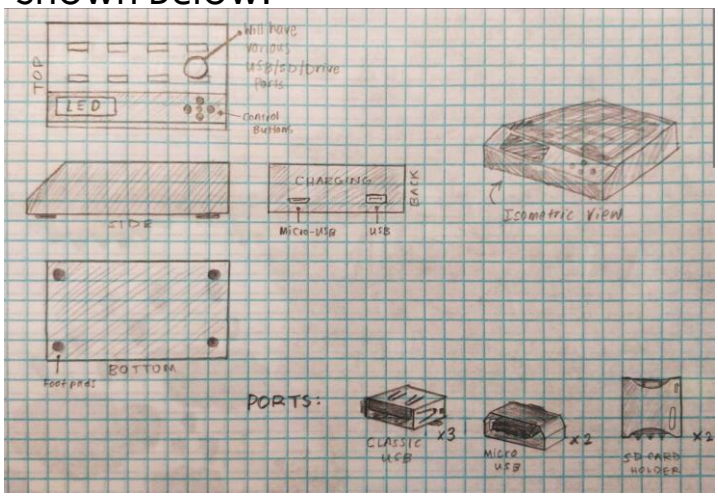
How often do you use USB storage devices?

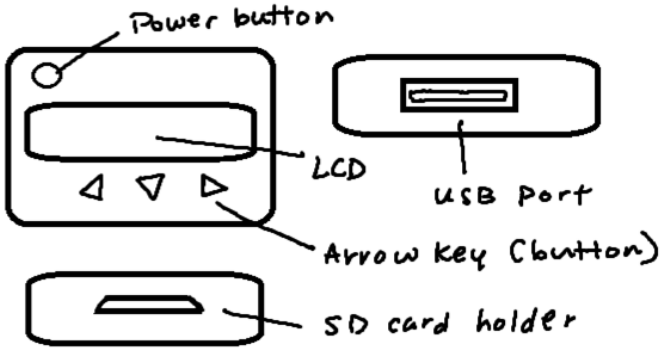
Do you find current methods of figuring out how much storage a USB drive has to be time consuming/difficult?



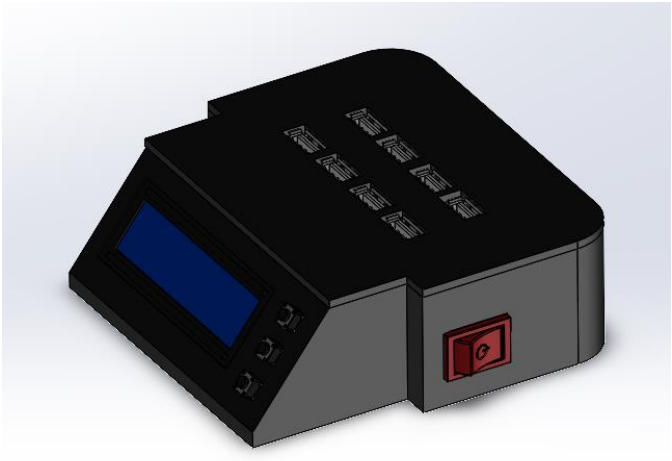
Initial Concepts

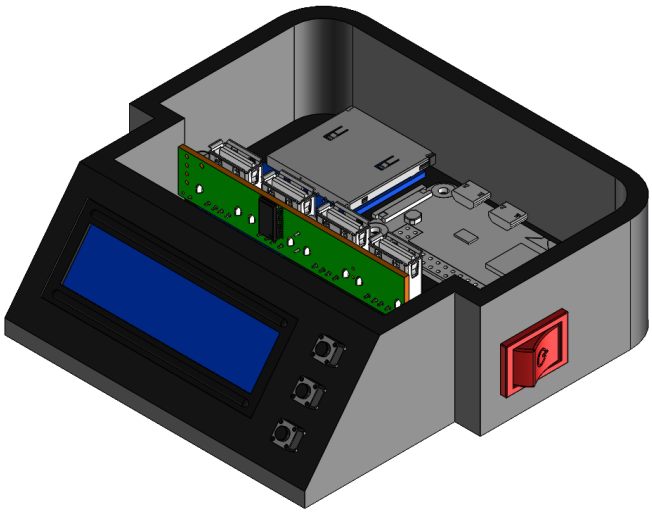
During the brainstorming process, we narrowed out choices down to two designs for our solution. We then created technical drawings for each, shown below:





CAD Design



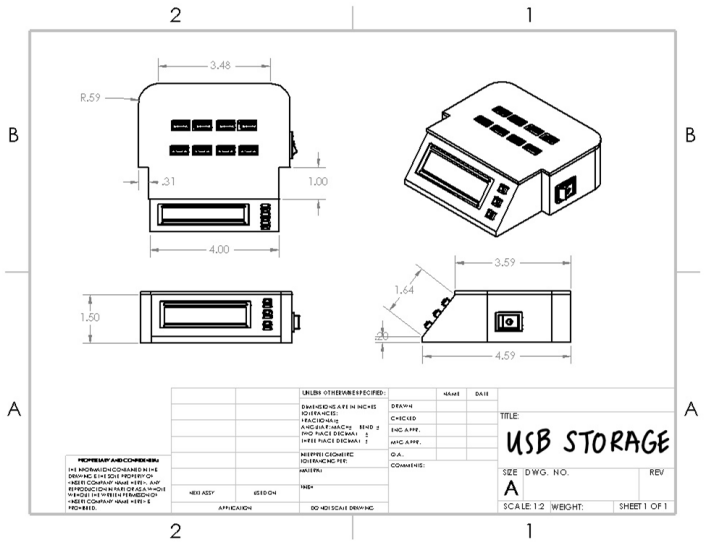


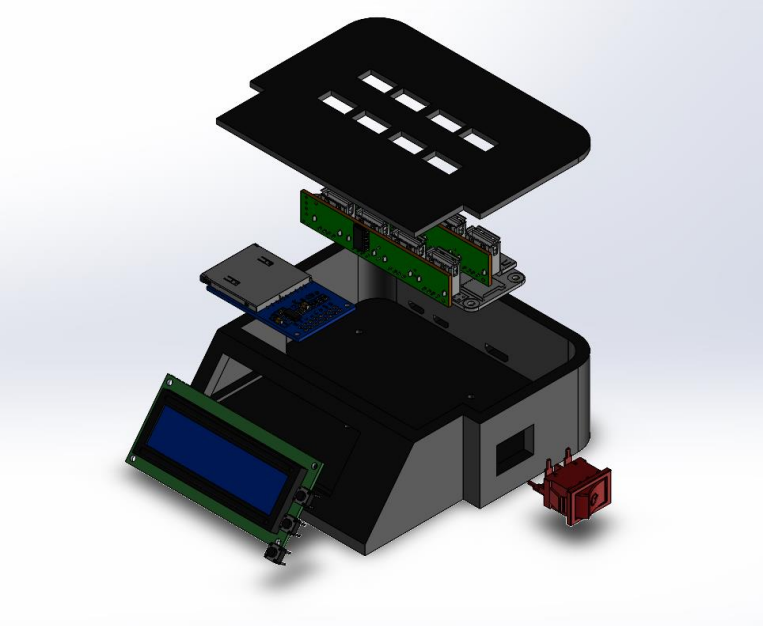
Decision Matrix

	Cost	Complexity	Ease of Use	Functionality	Total
Concept 1 (Larger)	3	4	4	4	15
Concept 2 (Smaller)	4	2	4	4	14

- 1 → Worst
- 5 → Best

CAD Design





Programming

```
import os.path  #import Python modules os.path and shutil for disk connection and storage monitoring
import shutil

def storage(i): #function for drive storage reading
    total, used, free = shutil.disk_usage('%s/' % i)    #variables for total, used, free storage on drive

    print('Total: %d MB' % (total // (10**6)))  #print storage to console
    print('Used: %d MB' % (used // (10**6)))
    print('Free: %d MB' % (free // (10**6)))

def diff(list1, list2): #function to build list of new drives
    list_difference = [item for item in list1 if item not in list2] #string comprehension
    return list_difference

def foo():  #new drive function
    print('New drive introduced')

def ham():  #removed drive function
    print('Drive disconnected')

dl = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'   #list of all possible drive paths
drives = ['%s:' % d for d in dl if os.path.exists('%s:' % d)] #list of all drives initially connected
print(drives)
while True:
    uncheckeddrives = ['%s:' % d for d in dl if os.path.exists('%s:' % d)]  #list of all drives connected
    x = diff(uncheckeddrives, drives)
    if x:   #commands for new drives
        print('New drives:      ' + str(x))
        print(storage(x[0]))
        foo()
    x = diff(drives, uncheckeddrives)
    if x:   #commands for removed drives
        print('Removed drives: ' + str(x))
        ham()
    drives = ['%s:' % d for d in dl if os.path.exists('%s:' % d)]   #updated list of all drives connected
```

Testing Procedures

Criteria/Benchmark	Description of Data Needed	Quantitative or Qualitative	Degree of Accuracy
The product must work consistently and quickly whenever an input device is plugged in	Whether or not a USB drive is successfully detected and information is provided	Qualitative	N/A
The finished product must be able to consistently survive a drop from a height of 4 feet	How high the product is dropped from before it ceases to function	Quantitative	+/- 1 in
The product takes less than 3 seconds to read the amount of storage left on a USB drive	How long it takes for the device to read the amount of storage on the USB drive	Quantitative	+/- 0.5 sec

Prototyping

Due to time constraints, we weren't able to complete a series of prototypes for testing. However, we were able to complete a functional script running on Windows CMD that can read the storage of input drives and print to console. Given another month or so, we would have been able to complete a functional prototype that acts as a USB hub and prints the amount of storage on the drive to an LCD display.

Code Test

```
['C:']
New drives:     ['D:']
Total: 8000 MB
Used: 7641 MB
Free: 358 MB
None
New drive introduced
Removed drives: ['D:']
Drive disconnected
```

Further Testing

As shown previously, we had tested our preliminary code and debugged it such that the code can detect a new USB drive plugged into a PC and return the amount of total, used, and free storage on the drive. More work on the code would need to be done in order to print the information onto an LCD display on our product. We would then need to conduct our tests, which include a drop test from up to 4 feet for durability, a consistency test where a drive is continuously plugged in and pulled out for, and a timing test to ensure that the device can function quickly.

Next Steps

If we had more time, we would have taken our CAD design and 3D printed the case and tested the fit of all the parts. We would then iterate upon our initial design until we make it perfect (with minimal waste and maximum functionality). From there we would start running tests on it to collect data and meet our testing standards. After ensuring that it is ready to be delivered as a final product, we would put together a final product and start marketing.

Acknowledgements

We would like to thank the following individuals:

- Our survey participants for giving us excellent feedback and helping us justify our problem
- Our classmates for giving us valuable feedback throughout the engineering design process
- Our teacher for guiding us through the design process while in a time-constrained virtual semester

Personal Statement

Through this project experience, we encountered many hardships that we had to overcome. Being virtual and only having a semester to finish a year-long project were both incredibly challenging constraints. Although I had prior experience with both programming and CAD, this course allowed me to better both of my skills. I also learned to document the entire process of engineering, as a lot of the information can be helpful as the project progresses. As for team dynamics, I believe both of us did a pretty good job of distributing work and collaborating, although at times one of us was more focused on a certain part of the project and less involved in another, which we could've worked on.