Assignment 4

directoryWalker

Solution Design

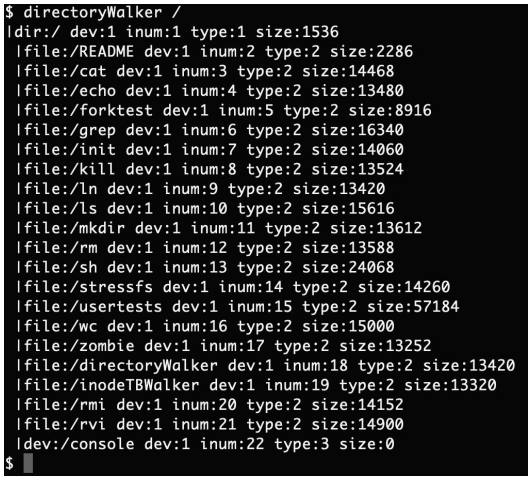
1. Create a system call named fileDirWalker in fs.c
2. Get inode struct from a path of directory.
3. Lock this inode by calling ilock
4. If the inode type is T_FILE or T_DEV, just print relevant info from inode.
5. If the inode type is T_DIR:
    a. print the info from inode at first.
    b. Because directory is a file containing a sequence dirent structure, we need to visit each of them and calculate the offsets. Once we get the file/directory name from a dirent structure, just concat it to the path to get a new path for the file.
    c. Recursively call fileDirWalker by passing the new path
6. Unlock this inode.
7. Create a user entry point in terms of directoryWalker in order to accept user input in shell and call the system call, fileDirWalker.

Related files

- fs.c – add fileDirWalker
- defs.h – add function declaration of fileDirWalker
- syscall.c – add sys_fileDirWalker
- syscall.h – add system call number named SYS_fileDirWalker
- usys.S – add SYSCALL(fileDirWalker)
- user.h – add system call declaration of fileDirWalker
- sysfile.c – add the implementation of system call named sys_fileDirWalker which calls fileDirWalker
- directoryWalker.c – implement the user entry point for directoryWalker

Test Case

From the following screenshot, the user program 'directoryWalker' not only correctly outputs names of files and directories from a given tree, but also prints out inode related info, such as device number, inode number, size and type.



inodeTBWalker

Solution Design

1. Create a system call named fileiTBWalker in fs.c
2. Walk through all the inodes from superblock
    a. Get a locked buf with the contents of the indicated block
    b. Get dinode struct from buffer struct
    c. If it's not a free inode, print out the inode number
    d. Release the locked buffer by calling brelse
3. Create a user program named inodeTBWalker in order to run it in shell

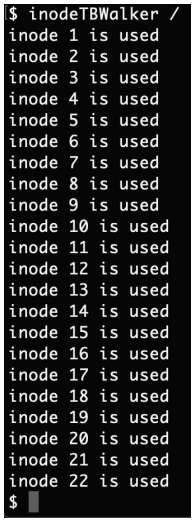
Related files

- fs.c – add fileiTBWalker
- defs.h – add function declaration of fileiTBWalker for fs.c
- syscall.c – add sys_fileiTBWalker
- syscall.h – add system call number named SYS_fileiTBWalker
- usys.S – add SYSCALL(fileiTBWalker)
- user.h – add system call declaration of fileiTBWalker
- sysfile.c – add the implementation of system call named sys_fileiTBWalker which directly calls fileiTBWalker
- inodeTBWalker.c – implement the user program in order to run it in shell

Test Case

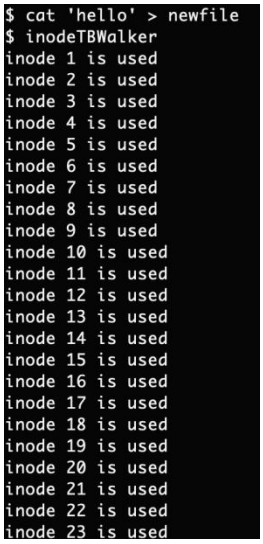
Case 1

The following test case prints out all allocated inodes.



Case 2

After creating a new file, the inodeTBWalker shows that the inode 23 is used, which is actually used for the new file. So the implementation is in accord with the requirements and expectations.



Comparison of two Walkers

The highlight is path -> inode number -> inode size; then inode number -> buf -> dinode -> block size. The two values of size should be identical.

Solution Design

1. Create a system call named compareWalker in fs.c
2. Get inode struct from a path of directory.
3. Lock this inode by calling ilock
4. Get a locked buf with the contents of the indicated block which is indexed by the inode number from the inode struct
5. Get dinode struct from buffer struct and get the block size.

6. If the inode type is T_FILE or T_DEV, just print relevant info from inode.
7. If the inode type is T_DIR:
    a. print the info from inode at first.
    b. Because directory is a file containing a sequence dirent structure, we need to visit each of them and calculate the offsets. Once we get the file/directory name from a dirent structure, just concat it to the path to get a new path for the file.
    c. Recursively call compareWalker by passing the new path
8. Unlock this inode.
9. Create a user entry point in terms of compareWalker in order to accept user input in shell and call the system call, compareWalker.

Related files

- fs.c – add compareWalker
- defs.h – add function declaration of compareWalker for fs.c
- syscall.c – add sys_ compareWalker
- syscall.h – add system call number named SYS_ compareWalker
- usys.S – add SYSCALL(compareWalker)
- user.h – add system call declaration of compareWalker
- sysfile.c – add the implementation of system call named sys_ compareWalker which directly calls compareWalker
- compareWalker.c – implement the user program in order to run it in shell

Test Case

From the following plot, we can see that dirWalker is able to generate inode number and data size from inode struct; Then TBWalker uses the previous inode number to get data size from dinode struct. We can easily see the data size from two Walker are identical, which proves they comes from the same inode and the correctness of the two Walkers.

Erase directory inode info

Solution Design

1. Create user program named rmi which erases the information in a directory inode.

2. Walk through all the files coming from user input:
    a. Get all the data addresses of a file's inode
    b. Declare and initialize a string for the saving path
    c. Set the saving path as '/recycle/' plus the filename for future file recovery
    d. Open the file in 'recycle' and copy those block addresses to the file.
    e. Unlink the file to remove it from disk.

Related files

- defs.h – add function declaration for getinode
- string.c – add helper function named strcat for string concat operation
- syscall.c – add sys_getinode
- syscall.h – add system call number named SYS_getinode
- usys.S – add SYSCALL(getinode)
- user.h – add system call declaration of getinode
- sysfile.c – add the implementation of system call named sys_getinode which directly calls getinode
- rmi.c – user program for erasing the information in a directory inode

Test Case

Case 1 for erasing a file

First of all, create a new file named newfile containing a simple string.

```
$ echo hello > newfile
$ cat newfile
hello
```

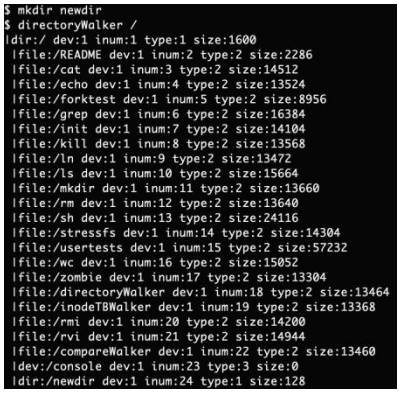
After calling the user program named rmi, we can easily see that the file doesn't exist in the file system by calling ls command. directoryWalker also confirms the inode is gone.

```
$ directoryWalker /
|dir:/ dev:1 inum:1 type:1 size:1728
 |file:/README dev:1 inum:2 type:2 size:2286
 |file:/cat dev:1 inum:3 type:2 size:14512
 |file:/echo dev:1 inum:4 type:2 size:13524
 |file:/forktest dev:1 inum:5 type:2 size:8956
 |file:/grep dev:1 inum:6 type:2 size:16384
 |file:/init dev:1 inum:7 type:2 size:14104
 |file:/kill dev:1 inum:8 type:2 size:13568
 |file:/ln dev:1 inum:9 type:2 size:13472
 |file:/ls dev:1 inum:10 type:2 size:15664
 |file:/mkdir dev:1 inum:11 type:2 size:13660
 |file:/rm dev:1 inum:12 type:2 size:13640
 |file:/sh dev:1 inum:13 type:2 size:24116
 |file:/stressfs dev:1 inum:14 type:2 size:14304
 |file:/usertests dev:1 inum:15 type:2 size:57232
 |file:/wc dev:1 inum:16 type:2 size:15052
 |file:/zombie dev:1 inum:17 type:2 size:13304
 |file:/directoryWalker dev:1 inum:18 type:2 size:13464
 |file:/inodeTBWalker dev:1 inum:19 type:2 size:13368
 |file:/rmi dev:1 inum:20 type:2 size:14200
 |file:/rvi dev:1 inum:21 type:2 size:14944
 |file:/compareWalker dev:1 inum:22 type:2 size:13460
 |dev:/console dev:1 inum:23 type:3 size:0
 |dir:/recycle dev:1 inum:24 type:1 size:192
  |file:/recycle/newfile dev:1 inum:27 type:2 size:56
 |dir:/recover dev:1 inum:25 type:1 size:128
```

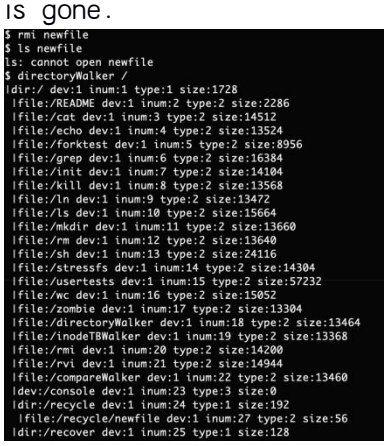
Case 2 for erasing a directory

First of all, create an empty directory named newdir.

Then call directoryWalker to ensure the inode of the created dir exists.



After calling the user program named rmi, we can easily see that the directory doesn't exist in the file system by calling ls command. directoryWalker also confirms the inode is gone.



File System Recovery

Solution Design

1. Accept user inputs for files to be recovered.
2. Loop over all files:
    a. Open the file under "/recycle/" given a filename.
    b. Read the content of the file including block addresses
    c. Create another file under "/recover/" with the same filename
    d. Initialize the file and try to load the data from those block addresses to the buffer
    e. Write the buffer to the file.
    f. Close the file

Related files

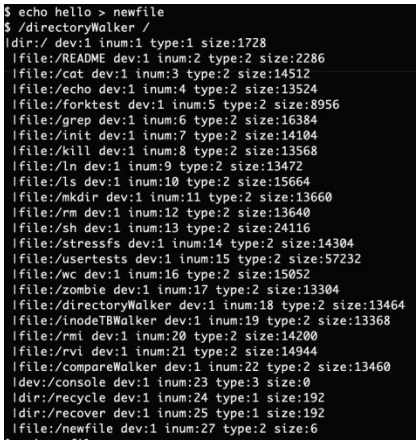
- defs.h – add function declaration for recoverb
- syscall.c – add sys_recoverb
- syscall.h – add system call number named SYS_recoverb
- usys.S – add SYSCALL(recoverb)
- user.h – add system call declaration of recoverb

- sysfile.c – add the implementation of system call named sys_recoverb which directly calls recoverb
- rvi.c – user program for recovering files

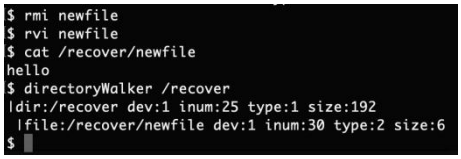
Test Case

Case 1 for recovering a file

First of all, create a new file with a string “hello” as its content. Use dirctoryWalker to find out the inode info.

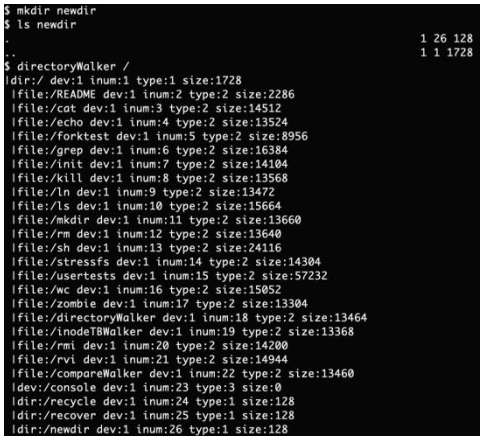


Call rvi after newfile destroyed by calling rmi. We can regenerate the file content from /recover/newfile. If we call directoryWalker for the path /recover, we can easily find out the recoverd file with the same size as the original one.

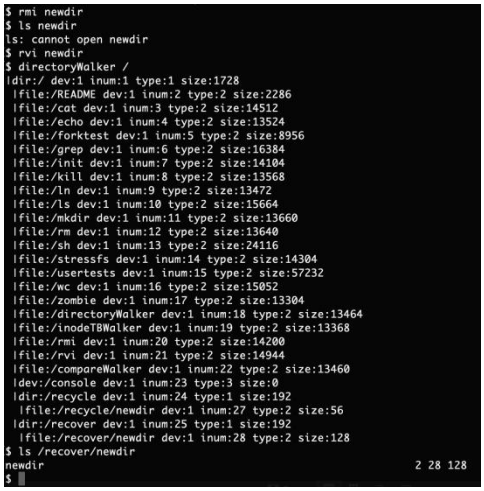


Case 2 for recovering a directory

First of all, create a new directory. Use dirctoryWalker to find out the inode info.



Call rvi after newdir destroyed by calling rmi. We can regenerate the directory from /recover/newdir. If we call directoryWalker for the path /recover, we can easily find out the recoverd directory with the same size as the original one.


$ rmi newdir
$ ls newdir
ls: cannot open newdir
$ rvi newdir
$ directoryWalker /
|dir:/ dev:1 inum:1 type:1 size:1728
 |file:/README dev:1 inum:2 type:2 size:2286
 |file:/cat dev:1 inum:3 type:2 size:14512
 |file:/echo dev:1 inum:4 type:2 size:13524
 |file:/forktest dev:1 inum:5 type:2 size:8956
 |file:/grep dev:1 inum:6 type:2 size:16384
 |file:/init dev:1 inum:7 type:2 size:14104
 |file:/kill dev:1 inum:8 type:2 size:13568
 |file:/ln dev:1 inum:9 type:2 size:13472
 |file:/ls dev:1 inum:10 type:2 size:15664
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 |file:/rm dev:1 inum:12 type:2 size:13640
 |file:/sh dev:1 inum:13 type:2 size:24116
 |file:/stressfs dev:1 inum:14 type:2 size:14304
 |file:/usertests dev:1 inum:15 type:2 size:57232
 |file:/wc dev:1 inum:16 type:2 size:15052
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 |file:/inodeTBWalker dev:1 inum:19 type:2 size:13368
 |file:/rmi dev:1 inum:20 type:2 size:14200
 |file:/rvi dev:1 inum:21 type:2 size:14944
 |file:/compareWalker dev:1 inum:22 type:2 size:13460
 |dev:/console dev:1 inum:23 type:3 size:0
 |dir:/recycle dev:1 inum:24 type:1 size:192
  |file:/recycle/newdir dev:1 inum:27 type:2 size:56
 |dir:/recover dev:1 inum:25 type:1 size:192
  |file:/recover/newdir dev:1 inum:28 type:2 size:128
$ ls /recover/newdir
newdir 2 28 128
$