National University
Of Computer and Emerging Sciences

SYSTEM CALL IMPLEMENTATION OF

CHAIN SMOKER'S PROBLEM

Teacher

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Group

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REPORT

INTRODUCTION

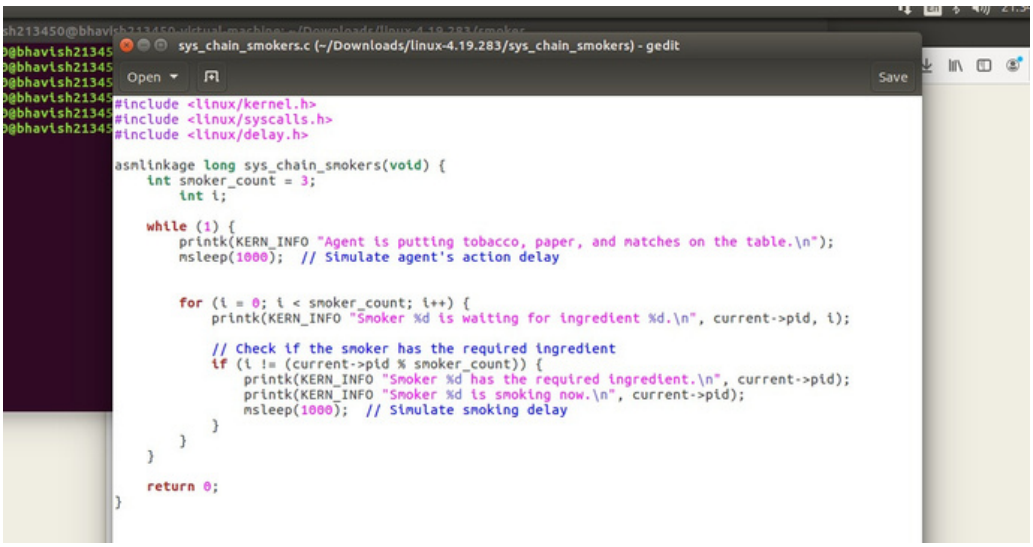
The purpose of this project report is to document the implementation of the Chain Smoker's Problem as a system call in the Linux Ubuntu kernel. The Chain Smoker's Problem is a classic synchronization problem that involves multiple processes with different resource requirements competing for limited resources. By implementing this problem as a system call, we aim to demonstrate the functionality and effectiveness of the Linux kernel in managing concurrent processes and resource allocation.

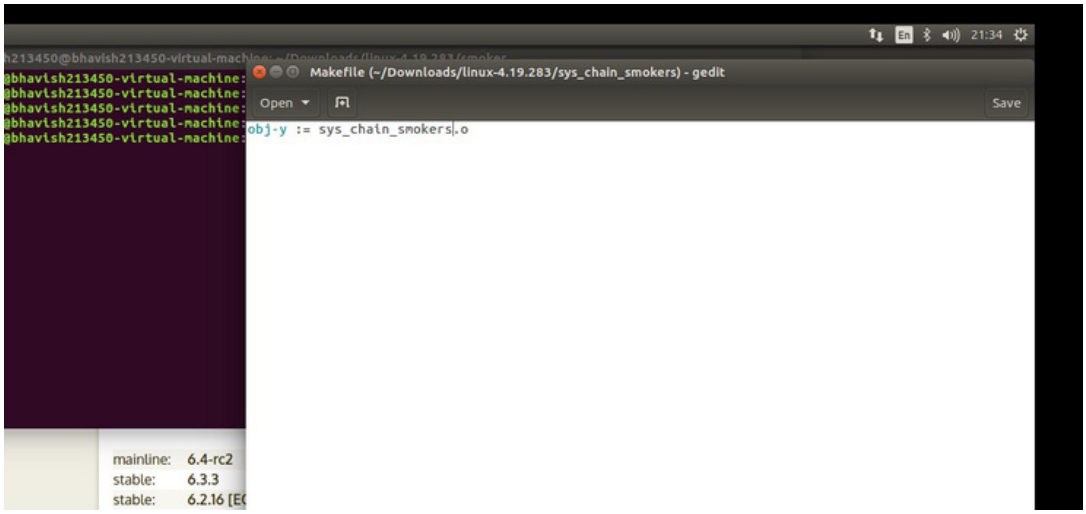
DESCRIPTION

The Chain Smoker's Problem involves three types of processes: smokers, an agent, and a mediator. Each smoker requires a specific set of resources to engage in their activity, and the agent and mediator are responsible for providing and coordinating these resources. The challenge lies in ensuring that only one smoker can utilize the resources at any given time, preventing conflicts and deadlocks.

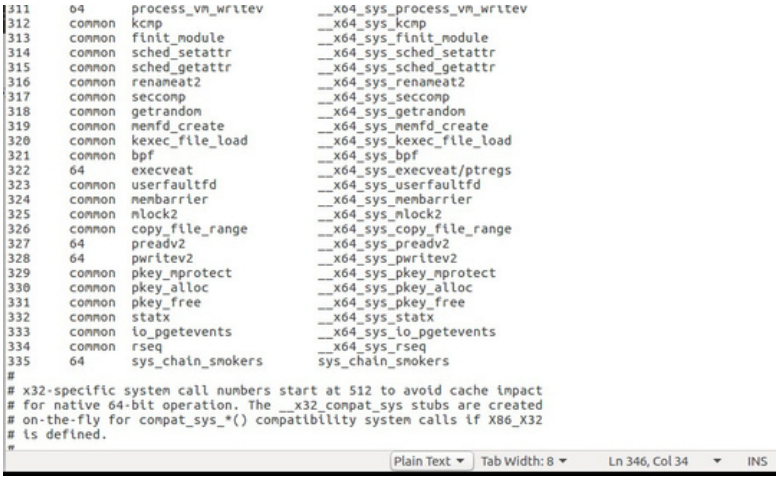
IMPLEMENTATION DETAILS

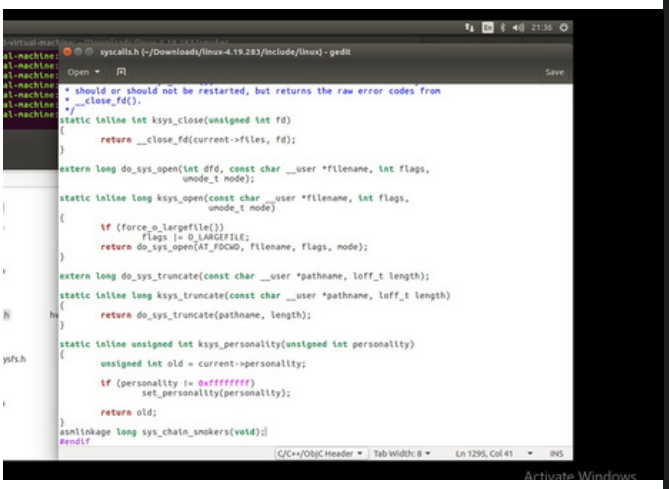
- **DESIGNING SYSTEM CALL**

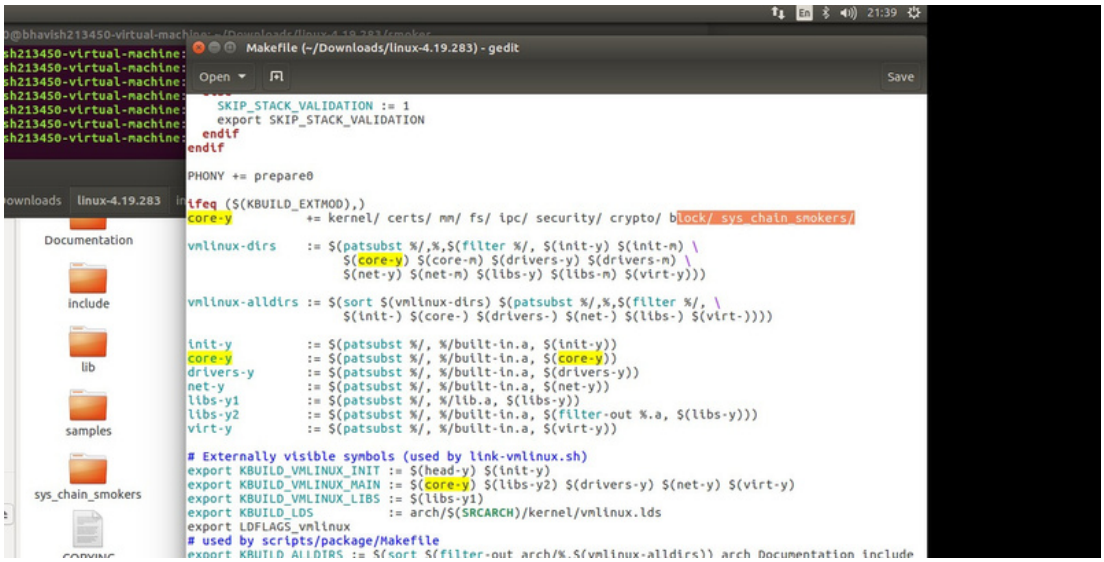




- **KERNEL PATCHING**







- **KERNEL PATCHING (CONTINUED)**

```
bhavish21k3450@bhavish21k3450-virtual-machine:~/Downloads/linux-4.19.275$ make clean -j4
bhavish21k3450@bhavish21k3450-virtual-machine:~/Downloads/linux-4.19.275$ make -j4
  SYSTBL  arch/x86/include/generated/asm/syscalls_32.h
  HOSTCC  scripts/basic/fixdep
  WRAP    arch/x86/include/generated/uapi/asm/bpf_perf_event.h
  WRAP    arch/x86/include/generated/uapi/asm/poll.h
  UPD     include/generated/uapi/linux/version.h
  DESCEND  objtool
  UPD     include/config/kernel.release
  HOSTCC   /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/fixdep.o
  HOSTLD   /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/fixdep-in.o
  LINK     /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/fixdep
  GEN      /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/arch/x86/lib/inat-tables.c
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/arch/x86/decode.o
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/exec-cmd.o
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/help.o
  LD       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/arch/x86/objtool-in.o
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/builtin-check.o
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/pager.o
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/builtin-orc.o
  CC       /home/bhavish21k3450/Downloads/linux-4.19.275/tools/objtool/parse-options.o
```

```
  LD [M]  sound/usb/snd-usb-audio.ko
  LD [M]  sound/usb/snd-usbmidi-lib.ko
  LD [M]  sound/usb/usx2y/snd-usb-us122l.ko
  LD [M]  sound/usb/usx2y/snd-usb-usx2y.ko
  LD [M]  sound/x86/snd-hdmi-lpe-audio.ko
  LD [M]  virt/lib/irqbypass.ko
bhavish21k3450@bhavish21k3450-virtual-machine:~/Downloads/linux-4.19.275$ make modules_install install
mkdir: cannot create directory '/lib/modules/4.19.275-213450': Permission denied
Makefile:1285: recipe for target '_modinst_' failed
make[1]: *** [_modinst_] Error 1
Makefile:286: recipe for target '__build_one_by_one' failed
make: *** [__build_one_by_one] Error 2
bhavish21k3450@bhavish21k3450-virtual-machine:~/Downloads/linux-4.19.275$ make -j4
  DESCEND  objtool
  CALL     scripts/checksyscalls.sh
  CHK      include/generated/compile.h
  Building modules, stage 2.
Kernel: arch/x86/boot/bzImage is ready  (#1)
  MODPOST 5026 modules
bhavish21k3450@bhavish21k3450-virtual-machine:~/Downloads/linux-4.19.275$
```

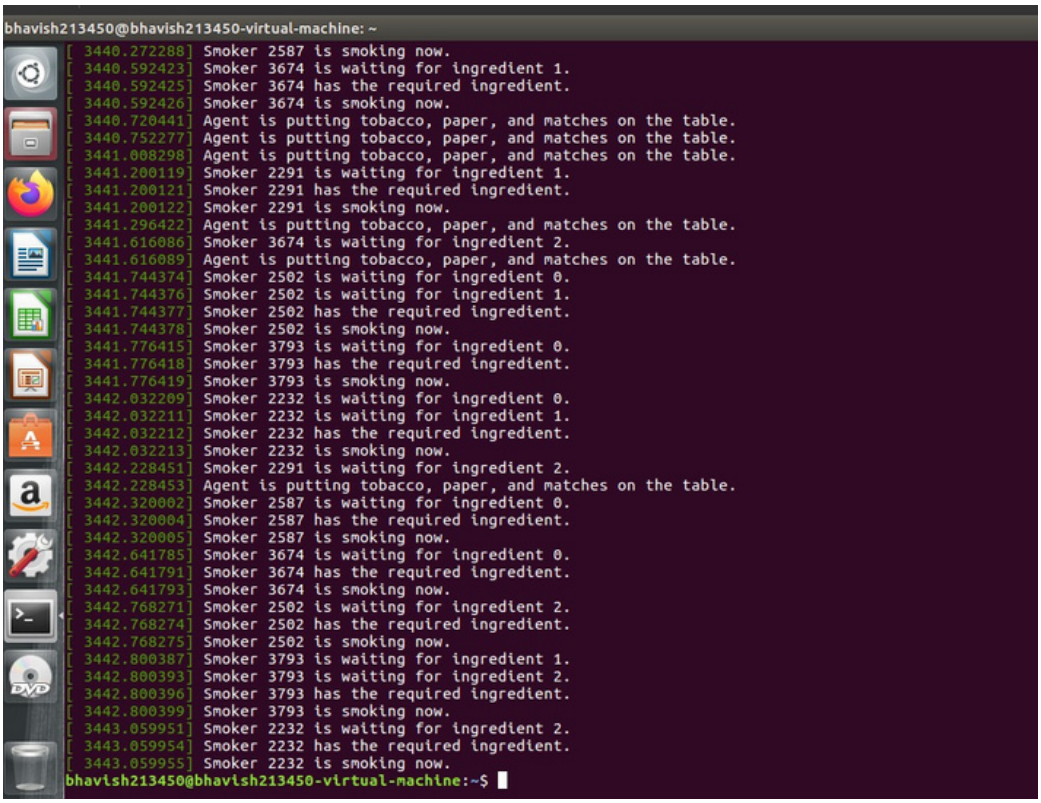
- **USERSPACE CODE**

userspace.c (~/) - gedit

Open

```c
#include<stdio.h>
#include<linux/kernel.h>
#include<sys/syscall.h>
#include<unistd.h>
int main()
{
        long int i = syscall(335);
        printf("System call sys_chain_smokers returned %ld\n", i);
        return 0;
}
```

- **OUTPUT**



CONCLUSION

Our implementation successfully demonstrated the ability of the Linux Ubuntu kernel to handle the Chain Smoker's Problem as a system call. We observed the expected synchronization behaviour and resource allocation, ensuring fairness and deadlock avoidance. The system call was performed efficiently, allowing for concurrent execution and proper management of resources.

In summary, this project report outlines the implementation of the Chain Smoker's Problem as a system call in the Linux Ubuntu kernel. It provides a comprehensive overview of the problem, implementation details, testing, and future possibilities.