```c
#include "_threadsCore.h"
#include "osDefs.h"

//global variables
uint32_t* endOfStack_ptr = NULL;
int numThreads = 0;
int idleIndex = 0;
threadStruct threadCollection[MAX_THREADS];

//obtain the initial location of MSP by looking it up in the vector table
uint32_t* getMSPInitialLocation (void){
  uint32_t* MSP_ptr = (uint32_t*) 0x0; //define a pointer to a pointer that points to initial MSP
  printf("MSP: %08x\n", *MSP_ptr);
  if(endOfStack_ptr == NULL){ //only allow endOfStack_ptr to be set to initial MSP location once
    endOfStack_ptr = (uint32_t*) *MSP_ptr;
  }

  return (uint32_t*) *MSP_ptr; //dereference so that it returns just the pointer to initial MSP
}

//return address of new a PSP with offset of "offset" bytes from MSP
uint32_t* getNewThreadStack (uint32_t offset){
  //check if we are exceeding the max stack size
  if (MAX_STACK < offset){
    printf("ERROR: Offset too large");
    return NULL;
      //make sure to look for a NULL return in future functions to check if getNewThreadStack failed or not
  }

  //calculate address of PSP from MSP
  uint32_t* MSP_ptr = getMSPInitialLocation();
  uint32_t PSP_adr = (uint32_t) MSP_ptr - offset;

  //check if PSP address is a number divisible by 8
  if(PSP_adr%8 != 0){
    PSP_adr = PSP_adr+sizeof(uint32_t); //add 4 to address to ensure valid address for the stack
  }

  //check if overwriting a previous stack
  if(PSP_adr > (uint32_t) endOfStack_ptr-(STACK_SIZE)){
    printf("ERROR: Overwriting old data");
    return NULL;
  }

  //assign PSP_ptr to point to PSP_adr
  uint32_t* PSP_ptr = (uint32_t*) PSP_adr;
  printf("PSP: %08x\n", (uint32_t) PSP_ptr);
  endOfStack_ptr = PSP_ptr;

  return PSP_ptr;
}


//LAB 1: set the value of PSP to threadStack and ensure that the microcontroller is using that value by changing the CONTROL register
/*void setThreadingWithPSP (uint32_t* threadStack){
  __set_PSP((uint32_t) threadStack);
  __set_CONTROL(1<<1);
}*/


//Initializes the thread stack and its initial context in memory
int osThreadNew(void (*fun_ptr)(void), int timeslice, int sleepTime){
  ++numThreads;
  int stackID = numThreads-1;

  //generate and store TSP
  if(threadCollection[stackID].fun_ptr == idleThread){
    threadCollection[stackID].TSP = getNewThreadStack(STACK_SIZE + numThreads*STACK_SIZE); //in the future, use a smaller stack size for idle & modify getNewThreadStack to allow for this
  }
```

```
70      else{
71        threadCollection[stackID].TSP = getNewThreadStack(STACK_SIZE + numThreads*STACK_SIZE); //MSP stack
    + n*thread stacks
72      }
73
74      //if getnewThreadStack encounters an error creating the thread pointer, TSP generated will be a NULL
    pointer
75      if(threadCollection[stackID].TSP == NULL){
76        --numThreads;
77        return -1; //osThreadNew failed
78      }
79
80      //set threadStruct params
81      threadCollection[stackID].fun_ptr = fun_ptr;
82      threadCollection[stackID].timer = timeslice;
83      threadCollection[stackID].timeslice = timeslice;
84      threadCollection[stackID].sleepTime = sleepTime;
85      threadCollection[stackID].waitMutex = NONE;
86
87      //set the values for what the "running" thread will populate the registers with
88      *(--threadCollection[stackID].TSP) = 1<<24; //xPSR
89      *(--threadCollection[stackID].TSP) = (uint32_t) fun_ptr; //PC (program counter)
90
91        //dummy values (need to be nonzero)
92        *(--threadCollection[stackID].TSP) = 0xE; //LR
93        *(--threadCollection[stackID].TSP) = 0xC; //R12
94        *(--threadCollection[stackID].TSP) = 0x3; //R3
95        *(--threadCollection[stackID].TSP) = 0x2; //R2
96        *(--threadCollection[stackID].TSP) = 0x1; //R1
97        *(--threadCollection[stackID].TSP) = 0x0; //R0
98
99        //dummy values (for testing purposes)
100       *(--threadCollection[stackID].TSP) = 0xB; //R11
101       *(--threadCollection[stackID].TSP) = 0xA; //R10
102       *(--threadCollection[stackID].TSP) = 0x9; //R9
103       *(--threadCollection[stackID].TSP) = 0x8; //R8
104       *(--threadCollection[stackID].TSP) = 0x7; //R7
105       *(--threadCollection[stackID].TSP) = 0x6; //R6
106       *(--threadCollection[stackID].TSP) = 0x5; //R5
107       *(--threadCollection[stackID].TSP) = 0x4; //R4
108
109     threadCollection[stackID].status = WAITING;
110
111     //if the idle thread is being initialized
112     if(threadCollection[stackID].fun_ptr == idleThread){
113       --numThreads;
114       idleIndex = numThreads;
115     }
116
117     return 0;
118   }
119
120   //idle function
121   void idleThread(void){
122     while(1);
123   }
```