TITLE OF THESIS (DOUBLE SPACED, ALL UPPER CASE, BOLD, AND CENTERED)

A Masters Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Computer Science

By

Thesis Student Name

September 2018

TITLE OF THESIS (DOUBLE SPACED, ALL UPPER CASE, BOLD, AND CENTERED)

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Master of Science

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ABSTRACT

The use of autonomous robotics in the field of exploration has drastically expanded with innovations in both hardware technology and the applications of artificial intelligence (AI). A wide variety of robotic agents and the environments that they can operate within has led to the creation of many unique control schemas that cater to each specific agent and their goal within an environment. Most control schemas must be built from the ground up for each given operation. Here we discuss a single, adaptive control solution for autonomous exploration across multiple agent setups, goals, and environments. The control schema utilizes a memory-based reinforcement-learning approach to efficiently analyze agent states for planning actions to safely navigate an environment and collect data to achieve a defined goal. The control schema was first tested in simulation against random and heuristic control schemas to compare performance. Next the controller was tested in simulation with alterations to the agent's sensors, environments, and goals to observe adaptability. Performance comparisons are made for each controller's goal completion, number of actions taken, and the remaining health and energy of the agent controlled. Results indicate that this control schema is both useful and adaptable to new situations. An adaptive control schema, such as the one presented in this research, could help provide a universal solution for building autonomous robots in the field of exploration.

KEYWORDS: (list at least five keywords or phrases here: use lowercase and separate with commas; note that if two lines are used, the second line is not indented)

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Missouri State University

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Dr. Julie J. Masterson, Graduate College Dean

ACKNOWLEDGEMENTS

If desired, a page can be inserted for the purpose of acknowledging the assistance and support of others. A dedication can be included as well, but serves a separate purpose. If used, it should be clearly delineated. Single spacing is acceptable if necessary to keep this all on one page.

I would like to thank the following people for their support during the course of my graduate studies.

A dedication can be included as well. It should be separated from the rest of the acknowledgement. The following is an example.

I dedicate this thesis to (insert person to be dedicated here).

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INTRODUCTION

As research in the fields of autonomous systems and robotics have become more extensive, it is evident that there are a wide range of application for robots with integrated autonomy. There are rovers, drones and even aquatic robots capable of intelligently selecting actions to perform in their environments. The tasks that these robots carry out greatly vary based on the robot's abilities and the environmental limitations. This variance causes a demand for distinct software and hardware that is required to achieve each robot's given task. Many similarities can be drawn from the wide rang of robots and their usage. Almost all autonomous robots operate through their use of observational sensors to gather data and a control schema to analyze the data collected and plan actions.

A great deal of research has been done in hybrid robots which use adaptive hardware that is multifunctional to various tasks. However, there is not an extensive amount of research on software with the capability to integrate with multiple robot compositions and tasks. Most of this is due to the fact that each robot has unique capabilities that do not overlap with many other robots. Autonomous robots tend to focus in on a certain niche that require their systems to be built from the ground up for each task presented. This leaves the question of what pieces of autonomous control can be abstracted.

There are many intelligent approaches that can be applied to decision making processes. The field of autonomous robotics has benefited tremendously through the growing field of artificial intelligence (AI). AI methods are commonly used in situations when there is a known number of controllable variables and a wide solution space to be explored. This makes them great candidates for creating a system which drives the decision-making process of an autonomous robots. In particular, neural networks and reinforcement learning architectures trained in simulations have yielded promising results for finding optimal control patterns in the diverse applications of autonomous robots.

The Surveillance Coordination and Operations Utility (SCOUt) system takes a top down approach to create an adaptive control schema for diverse robotic agents and their uses by abstracting the very basics of autonomous robotics. This control schema repeatedly follows the process of collecting of data from sensors, analyzing the agent's state, and the outputting response controls to complete surveillance based operations. SCOUt uses memory based reinforcement learning to make state based action decisions. The abstraction of this process allows the collected memory pool to be used adaptively across varying environments and robot setups.

CONCLUSION

Here it will end.

REFERENCES

Appendices

ALGORITHMS

Sample Algorithm

In Algorithm 1 we show how to calculate $y = x^n$.

Algorithm 1 Calculate $y = x^n$

Require: $n \geq 0 \vee x \neq 0$
Ensure: $y = x^n$

$y \leftarrow 1$
if $n < 0$ **then**
  $X \leftarrow 1/x$
  $N \leftarrow -n$
else
  $X \leftarrow x$
  $N \leftarrow n$
end if
while $N \neq 0$ **do**
  if N is even **then**
    $X \leftarrow X \times X$
    $N \leftarrow N/2$
  else $\{N$ is odd$\}$
    $y \leftarrow y \times X$
    $N \leftarrow N - 1$
  end if
end while

CODES

Sample Code

We use this code to find out. . .

```c
#include <stdio.h>
int Fibonacci(int);

main()
{
  int n, i = 0, c;

  printf("Enter␣the␣value␣of␣n:␣");
  scanf("%d",&n);

  printf("\nFibonacci␣series\n");

  for (c = 1 ; c <= n ; c++)
    {
      printf("%d\n", Fibonacci(i));
      i++;
    }

  return 0;
}
```

```
int Fibonacci(int n)
{
  if (n == 0)
    return 0;
  else if (n == 1)
    return 1;
  else
    return (Fibonacci(n-1) + Fibonacci(n-2));
}
```

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This thesis was generated on Tuesday 30th October, 2018 at 7:51pm.