MULTI-AGENT COORDINATION USING ROBOCUP RESCUE SIMULATION

A DISSERTATION

Submitted in partial fulfillment of the
Requirement for the award of the degree

Of

INTEGRATED DUAL DEGREE

(Bachelor of Technology and Master of Technology)

In

COMPUTER SCIENCE AND ENGINEERING

(With Specialization in Information technology)

BY

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Roorkee - 247667, India
December, 2018

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Enrolment No: 10211017

Under the supervision of

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December, 2018

AUTHOR'S DECLARATION

I declare that the work presented in this dissertation with title, Multi-Agent Coordination Using Robocup Rescue Simulation towards the fulfilment of the requirements for award of the degree of Integrated Dual Degree in Computer Science & Engineering, submitted to the Department of Computer Science & Engineering, Indian Institute of Technology Roorkee, India, is an authentic record of my work carried out during the period from January 2018 to December 2018 under the guidance of Dr. Rajdeep Niyogi, Associate Professor, Department of Computer Science and Engineering, Indian Institute of Technology, Roorkee. The content of this dissertation has not been submitted by me for the award of any other degree of or any other institute.

Date:

Place: IIT Roorkee

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CERTIFICATE

This is to certify that the statement made by the candidate in the declaration is Correct to the best of my knowledge and belief.

Dr. Rajdeep Niyogi
(Supervisor)
Associate Professor
Department of Computer Science &Engineering
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Date:

Place: Roorkee

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Mohit Kumar Bagdi

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Abstract

Applying Multi-agent coordination techniques in RoboCup Saving model rivalries has been an important part of RoboCup and the knowledge grown during the RoboCup Rescue Simulation rivalries has enhanced coordination among agents including Mechanical related for tragedy mitigation since 2001. Robocup Rescue Simulation System (RCRSS) is a dynamic arrangement of multi-agent coordination of a huge scale urban disaster situation. Agent wants to save citizens jammed in a town which has been hit by the tragedy and struggling with impairments on time, groundwork destruction, interconnection and attentiveness. Management among agents has always been a key in agent coordination and also plays very important role in disaster management. This research provides of the applying coordination among agents to the development of required behaviours to perform good in the RCRSS because this empowers machines to learn Skills. It provides a real time Situation with complex features and sensor facts that is both noisy and limited. This research is related on application to creating different strategies for multi-agent contexts and describes another multi-agent arranging approach connected to the RoboCup Rescue issue. So we can say this examines the correspondence procedures in a multi-agent framework of the disaster for executives. Reaction time could be enhanced if different organizations associated with rescue operations like police constrain, Fire Bridge and Ambulance teams dispatch a planned response to a tragedy situation. The main and important aim is to apply the available tragedy management to control flames, clear roads, and protection of people.

Contents

CHAPTER 1: INTRODUCTION

The most important target of simulation competition is to build each year the test and to drive the advancement of the session. Coordination is additionally required to react with suitable number of faculty and hardware. Our outcomes demonstrate an enhancement in execution of the RCRSS operators when the specialists utilize our correspondence convention. Agents designed with the intention with saving citizens jammed in structures with fires in a town which has been hit by a tremor. Tragedy managing and city find and saving is an open area of research for artificial intelligence (AI) and multi-agent structures scholars. This Study not only has the probable for an enormous public effect but also offerings a lot of challenges. An exploration and saving system has a large quantity of heterogeneous managers who have to perform in actual-time in an unfriendly situation with partial information and control while opposing problems of logistics, planning and teamwork. RoboCup Rescue Simulation was projected in as a regular trainer for scholars in the range of tragedy administration and city exploration and saving. Generally we try to implement our research by simulation process but we will talk about our dissertation in step by step. We are starting with the basic information regarding robocup rescue simulation system.

1.1 What is Robocup?

Robocup is a competition of robotics which held annually. This is an international competition. Anyone can participate in the robocup competitions. This Robocup competition was established in 1996 by a gathering of college Professors. There are So many different types of the events in this competition, like, “RoboCup Soccer league”,"RoboCupRescue comppetition", "RoboCup@Home" and "RoboCupJunior". According to report by the middle of this century, a group of completely free team of hominid robot soccer players will win a soccer match, consenting to the official principles of FIFA, beside the champion of the latest World Cup [1]. So we can say that we can have so many different and new ideas through these type of competitions. The interest in robocup is increasing day by day on a large scale.

1.2 What is Robocup rescue simulation system?

After the Kobe (Japan) earthquake in 1995, Japanese researchers thought of building up a test system that recreates conditions like urban Post earthquake for assessment relief procedures for this sort of disaster. The RoboCup Rescue competition is a part of the Famous RoboCup Soccer (RCS) league. Like RCS, RCR is additionally a multi-agent league in both mechanical technology and artificial intelligence. The RCR, be that as it may, includes a more of puzzling condition than its forerunner with different groups of participating operators and dynamic objectives. The RCR framework models a vast scale urban disaster situation like the result of an earthquake in a densely populated city. We can see a scenario after a tragedy in a populated city by following figure.

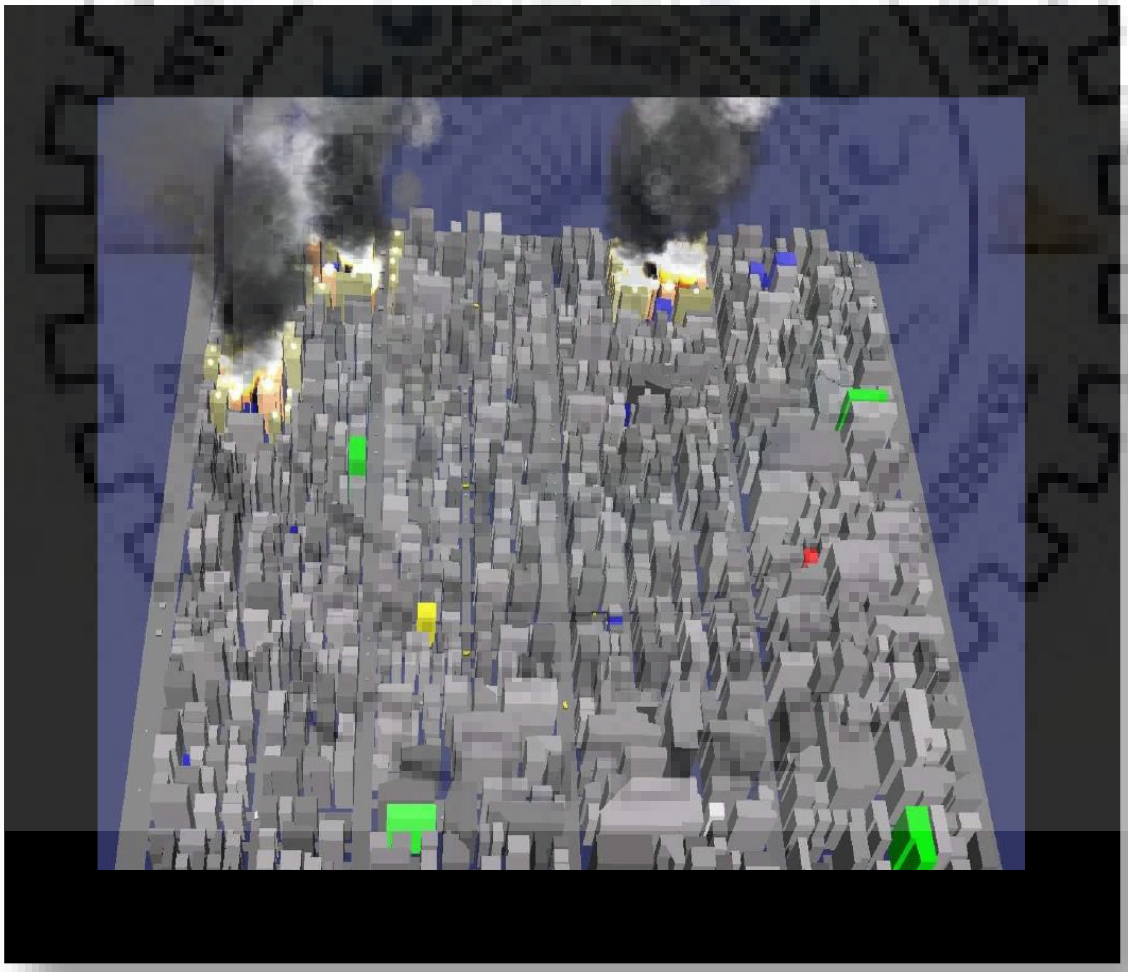

Figure 1.1: A Typical Disaster Situation [2]

This is the scenario after tragedy in a city. Some buildings are damaged because of earthquake and got fire. People are trapped in worst situation. The RoboCup saving model tries to serve a simulation of a post-earthquake situation and dealing with real objects and aptitudes in restrictions of terms. There are some issues to make the simulation realistic:

- Heterogeneity,
- Less info,
- Less communication networks,
- Arrangements,
- Actual-time is reflected,
- Describing this as a compound multi-agent area.

The main problem to make simulation realistic are less information about the location and communication. Disaster is a situation where time plays an important role in rescue operation and if our planning isn't perfect than we cannot produce a satisfactory result in this simulation. So we need to look in the situation and prepare some basic ideas to face problem. The rescue issue can be separated into three primary steps:

(A) Smothering fires,
(B) Rescue regular citizens, and
(C) Clearing blocked streets

Noticing progresses to arrangements and refuges will be done exclusively by all agents. Dousing structures must be finished by flame units. Protecting covered regular people and moving the harmed ones can as it were be finished by the ambulance groups. Clearing road blocks must be finished by police powers. If we are able to make the solutions for these problems then we can have a good result in which we will save so many citizens and buildings. We need to program our strategy according to effected city. We should have a proper planning for extinguish fire, saving people, clearing roads, so that our agents can perform well in this robocup rescue simulation system. The main thesis concerns are saving strategies of the agents, communication, bringing together and road scheduling. Worldwide Competition in RCR occur every year. The general objective is to create vigorous programming frameworks that are prepared to do efficiently planning wide operator groups for Urban Search and Rescue (USAR).

We will understand a screenshot of Robocup rescue simulation system. The blue circles, white circles and circles in red on the map symbolise police agents, ambulance teams and fire brigade units correspondingly. There are 3 category of health signals: (1) bright green, (2) dull green and (3) black circles related to healthy, hurt and dead civilians in that instruction. Yellow, orange, maroon color indicates the aggregate concentration of fire in structures. The black colour signifies totally burned and damaged buildings.

There are 2 main types of arrangements in the map: the green Buildings are the shelters and the white buildings are the centers for agents. Civilians can be rescued by moving them to the refuges. Refuges are also used to replenishment water in fire brigades. The centers are the police office, the ambulance center and the fire station act as central points of organization for the agents. The cross symbols on the road signify the barriers due to dropping remains. The map also displays the time step of the simulation and the existing score. The simulation runs for many time steps. The purpose of the simulation is to improve police, ambulance and fire brigade agents and their own centers which action in this undefined and tough situation to save civilians and protect buildings from destruction and fire.

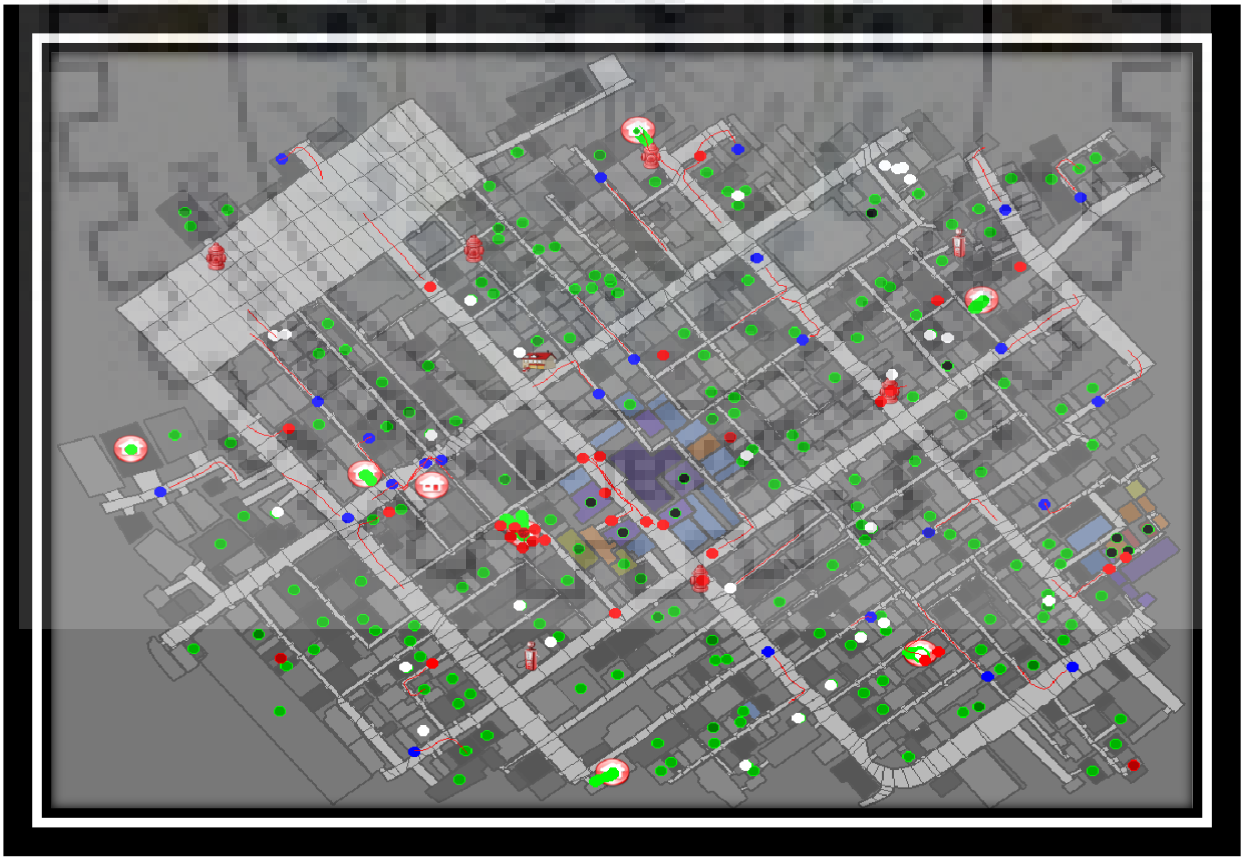

Figure 1.2: A Screenshot of RCRSS [3]

The RCRSS goals to improve simulants that form the structure of the scheme and imitate accurate occurrences principal in tragedies and it targets to produce intellectual representatives and machines that are given the abilities of the main performers in a tragedy situations. The League has three main rivalries which will be defined in the following units. Three RCR alliances exist:

(1) Agent competition,

(2) Infrastructure competition,

(3) Virtual robot league.

(1) Agent Competition:

The rescue agent challenge expects to use simulator for vast scale disasters and to explore better approaches for self-sufficient coordination of defend crowds as a methodology of disaster help after true occurrences. This includes of a simulation stage which looks like a city after a seismic earthquake. Police and rescue vehicle group specialists attempt to extinguish fire and protection victims in the structures. Scoring is determined by on rescue of the no of incapacitated specific, protected wealth on period and the amount of configurations with devastation. The important state and construction of the town show is given by the GIS segment, interconnection among all sections is implemented by TCP/IP on message passing. The test systems inside each release were always made steps. The situation symbolizes tragedy region, the number of different type agents, the position of the first start points, structure down fall, block roads, obtainability of message among agents are some conditions of the disaster relief simulation. We can say that contestants need to improve procedures which are appropriate for every situation.

(2) Infrastructure competition:

The framework rivalry has begun in 2004 with the motivation behind promoting the advancement of new test systems and instruments to continually enhancing the rescue test system. The renovation of different failure circumstances ends up being confused and difficult to approve. In this manner, the foundation rivalry has been propelled for supporting the maintenance and advancement of the simulator. Another test system segment proposed in the framework rivalry, which is effectively utilized, is the good test system. The victor of the framework rivalry is required to join the maintenance councils. The vast majority of these developments were basically proposed through the Infrastructure rivalry.

(3) Virtual Robot league:

RoboCup Virtual Robot leagues are being held since 2006. Principally logical teams from all colleges with association in the RoboCup Rescue Robot rivalries. People checking unfortunate casualties including injured individual discovery like programmed recognition of exploited people from sensor information. Some competitions were related to boost flexibility but the most important league is Multi-robot control in which the capacity to control different stages with a private administrator in reasonable conditions implies that the robots must be semi- self-sufficient. The principle challenge for the groups is the control of an extensive group of robots by a private administrator. These types of competitions are famous in youth. They have so much interest in virtual robotics.

1.3 What is Multi-agent Coordination?

If we talk about in computer science regarding multi-agent coordination, so it is an involvement of coordinating the resources and activities of multiple agents. "Multi-agent planning is concerned with planning by (and for) multiple agents. It can involve agents planning for a common goal, an agent coordinating the plans (plan merging) or planning of others, or agents refining their own plans while negotiating over tasks or resources. The topic also involves how agents can do this in real time while executing plans (distributed continual planning). Multi-agent scheduling differs from multi-agent planning the same way planning and scheduling differ: in scheduling often the tasks that need to be performed are already decided, and in practice, scheduling tends to focus on algorithms for specific problem domains". [4] Coordination can be well-defined as the action of management the inner needs among the actions of the agents in command to keep the system consistency. Order learning in agreeable multi-operator frameworks into two general classifications: group learning and simultaneous learning. In group taking in a solitary student is prepared to control a group of operators. This may prompt a bigger inquiry space as the single student must record for cooperation inside the group. We can use multi-agent coordination in so many sectors, but it has become an important section when we use it in robocup rescue simulation system. Agent shows a vital part in the procedure of multi-agent bringing together. We are going to talk about all the agents to use step by step.

The main group of experts might be:

(a) Heterogeneous, where various practices are found out by a solitary student one for every specialist.
(b) Homogenous, where a solitary conduct is found out and cloned to various specialists.
(c) Hybrid, where the group is isolated into heterogeneous "squads" of homogenous specialists.

This manner it is a proper framework for the advancement and assessment of novel methodologies. The structure is planned to be an appropriated, measured instrument that takes into account Characteristic kinds of physical reform. This framework has various highlights that make it intriguing for machinist based research including a dynamic domain, constrained data, Questionable data, constrained correspondence, and constrained handling time. The decision of test system parts (example: building breakdown, fire, damage) can be controlled with set of choices. These new highlights make it a perfect stage for multi-operator agents to use for creating, testing and benchmarking their calculations what's more, approaches. Clients can control the test systems and agents in the middle of a run whenever wanted. All agents are helpful to each other in the simulation system. They always try to work as a team. We can say that multi-agent coordination is the main tool in robocup rescue simulation system and have an important role in this process.

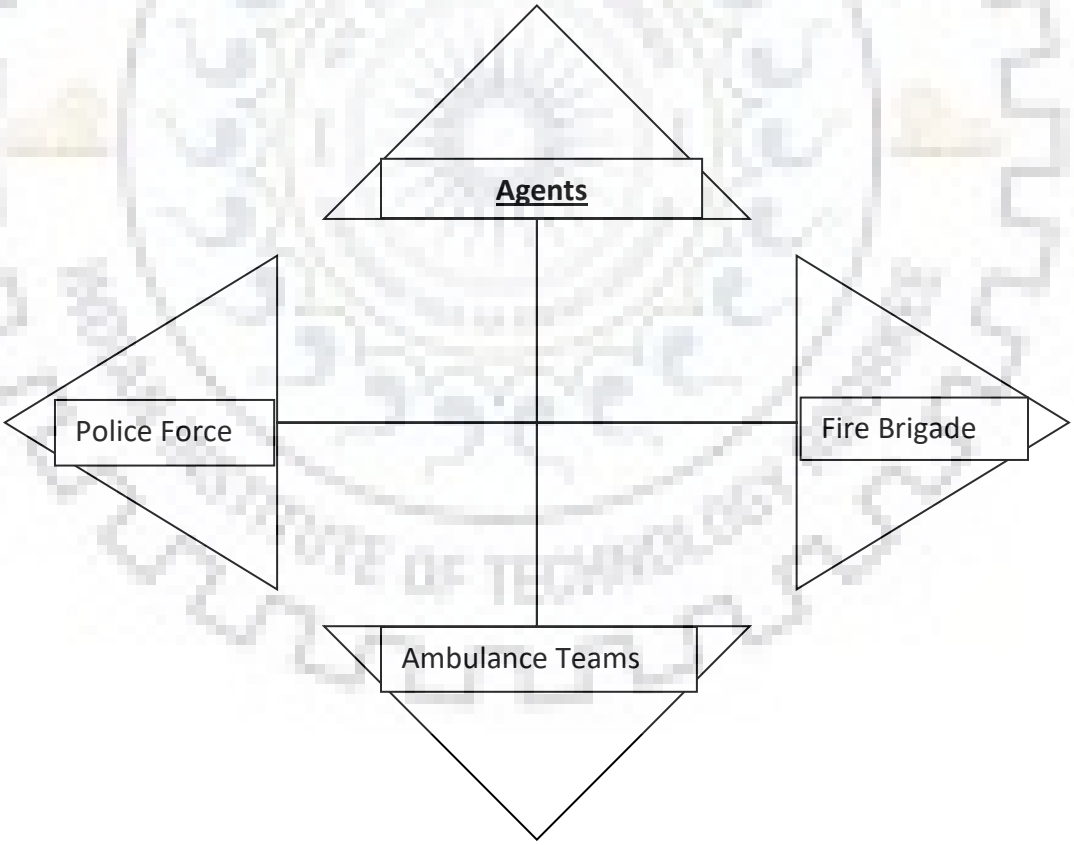

Figure 1.3 Agents for RoboCup Rescue Simulation

As a built up competition of so many years, RCR offers an institutionalized recreation condition as well as plenty of benchmark results from the majority of the past contending leagues. Rather than regulatory real robots, here we try to create a simulation environment which is given to imitate a post-earthquake disaster situation. This proposal emphases on the simulation specialist alliance. In particular, there are 3 agents Ambulance, Fire Brigade, and Police Force agents, which must protect people, douse flames, and clear roadblocks separately. Every agent assumes a vital job in the mitigation of this restructured emergency, both independently and related to one another.

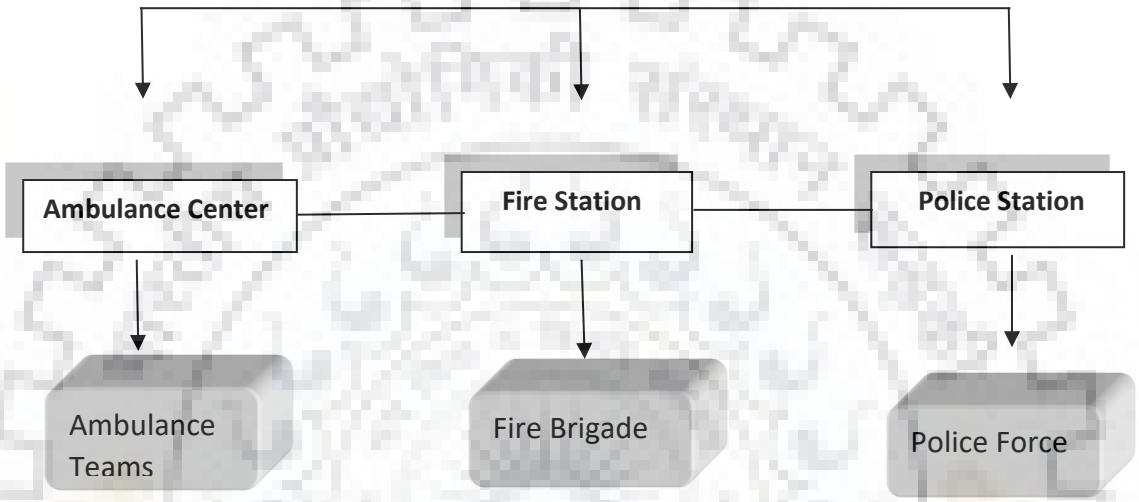

Figure 1.4: Coordination among agents and their center

We can understand the coordination among agents by this figure. All agents have own importance during the period of simulation. Ambulance teams are connected to a particular center named ambulance center. Fire brigade is connected with fire station. PF is connected with a police center. The centers are linked with each other and can exchange message among them. They can also use interconnection with each other whenever they like to during model running duration. Agents try to cooperate another agent in rescue operation. Centers are also responsible to help in the simulation. They work like a team in this operation. There are rescue operations in this simulation:

- Extinguish Fire
- Rescue Citizens
- Clearing Roadblocks

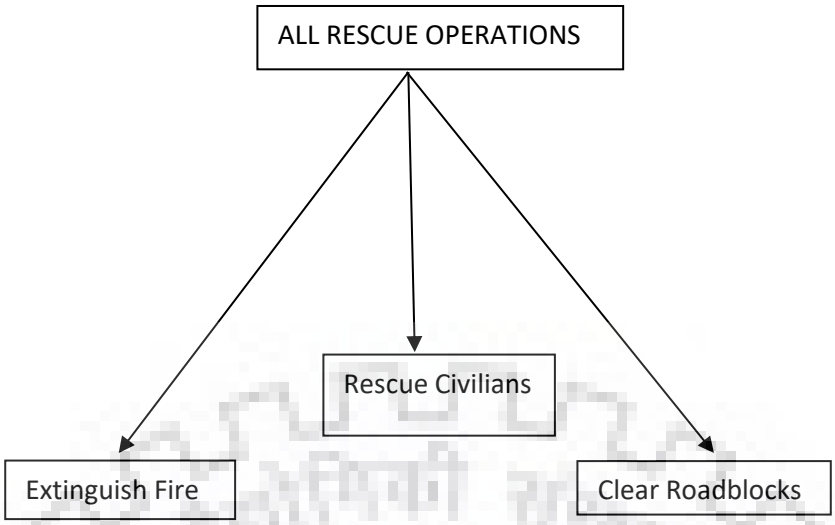

Figure 1.5: Rescue Tasks Tree Structure

1.4 Purpose and Limitations of the problem:

The RCRSS activities to demonstrate a genuine vast scale urban disaster. As needs be, the targets of the reproduction are like those you would expect in a genuine world disaster. The primary explanation for demonstrating the issue as a multi-agent arranging issue is the simplicity of undertaking definition and division. The structure explained the accompanying part how the unique periods of multi-agent arranging are made and how they add to take care of the issue. This paper demonstrates a novel methodology of displaying the save issue as a multi-operator arranging issue. A multi-agent correspondence demonstrate was made for operators to trade data and request help. The two primary destinations are the minimization of civilian's personnel losses (and wounds) and the minimization of harm done to structures by flame. A third sub-objective is the clearing of garbage from the streets. Three sorts of operators exist in this condition and are separately entrusted with achieving these goals. These specialist types are the Ambulance Teams (AT), Fire Brigades (FB), and Police Forces (PF). This task can be practiced by anybody of the three kinds of operators (AT, FB, and PF). Such a forced awareness of a quickly changing condition implies that operators must be exceptionally versatile so as to continue with their goals. All agents should keep in touch with each other so that they can communicate on different type problems related rescue operation in disaster situation. This will enhance their efficiency and they can save more citizens who are suffering due to an earthquake or tragedy.

All Types of rescue operations have different type of importance. When a disaster hit a city that city faces so many problems. So, at that time management of the situation became important. In a tragedy we have to make a combination of all different type of agents for the rescue operation. Extinguish fire operation helps the rescue operation very much and clearing roadblocks operation helps Extinguish Fire operation to make it in time. So they are associated with each other in any type of situation. Their full effort is necessary for the rescue operation.

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Chapter 2 Background Information

Background info is important for research area and info have a unique role in thesis. This chapter offerings background information necessary for the rest of this thesis. Specifically, the sections of this chapter describe RoboCup Rescue and previous works related to these topics and this thesis as a whole. The Rescue Simulation League has a long history.In the earlier years there have been numerous activities on robot rescue competitions, which frequently have an imitation part. On January seventeenth 1995, the Great Hanshin Earthquake hit the Japanese port city Kobe. It measured 6.8 on the Moment size scale, causing around 6500 deaths, and upwards of $100 billion in damage. The size of the destruction was to a great extent because of the high density of the populace in Kobe. [9]

If we talk about past years of Rescue Simulation League then the RoboCup Rescue Simulation League (RSL) began and The RSL points to create reproduction conditions which benchmark the insight of delicate product operators and robots with the capacities for settling on the correct choices autonomously in a disaster reaction situation. Two noteworthy rivalry of the RoboCup Group, to be definite the Agent and the Virtual Robot rivalries are labelled in the consequential fields. In light of this disaster it was chosen that the present tragedy help strategies should have been reconsidered and rebuilt. On April 30th 1999, at the area of Japan's nearby RoboCup Soccer (RCS) rivalry, it was chosen that a test system would be made to show large scale urban disasters, and the Robocup Rescue Simulation System (RCRSS) and Robocup Rescue (RCR) group were established. Expanding on the achievement of RCS, it is important that the RCR test system and challenges will serve to advance worldwide research coordinated effort in the fields of AI and apply independently, at the progression of improved save capacities. RCR is a post-seismic earthquake urban devastation relief reproduction. These type simulations helped a lot in past for rescue operations and multi-agent coordination. This is a huge part of competition. We are going to discuss important aspects regarding the background of robocup rescue simulation system in steps. We are starting with the history of all the competition regarding robocup rescue simulation systems in last 18 years.

2.1 18 Years of RoboCup Rescue:

Intellectual RoboCup saving rivalries have been started around 18 years ago. To rejoice years of investigation and growth in this publically related creativity this section gives an overview of the understanding extended. This part delivers an impression the art and the instructions taken from the earlier Robocup Rescue oppositions. The search and rescue (USAR) scenario offers a great potential to inspire and drive research in multi-agent and multi-robot systems. In this article we like to introduce the RoboCup Rescue leagues, which are respectively the Rescue Robot League (RRL) and the Rescue Simulation League (RSL) [5, 6]. Tragedy mitigation is a central public subject comprising big facts of various agents stand-in in unfriendly situations. The associated Urban Search and Rescue (USAR) scenarios have great potential for inspiring and driving research in both multi-agent and multi-robot systems. From the time when the situations through real USAR assignments are particularly puzzling [7]. Robots that can circumnavigate over pretentious zones after a tragedy, most probable will also be skilled of transferring the very same situation under ordinary surroundings. If robots are capable to identify human being under loads of debris of misshapen structures, they will also be capable to identify them within their normal situations. The main aim of these competitions is to relate the enactment of altered procedures for organising and supervisory teams of either robots or agents execution in tragedy modification.

This is a continuous process of learning. We all work like a chain system. We learn from our past and make the future brighter. So it is very important to study about past researches. Still there are so many sections in which we do a lot in the field of rescue operations. So the structure is planned to be a spread, segmental instrument that permits for different types of physical imitation as well as agents to be verified. The present operation representations a major earthquake in a city situation. Agents are programmed to use their powers to control the city's reserve facilities. The main root of the arrangement has been reformed to make it relaxed to outspread. New fields can be supplementary by executing the area substances as a programming language matters. Remaining emulators will basically overlook any area substances they do not understand. Now we are going to talk about simulator design and implementations of our programme.

2.2 Simulator Design and Implementation:

The RoboCup Rescue Agents simulator targets to deliver a simulation of a post-earthquake situation, simulating Actual situation substances' behavior and humans' abilities and restrictions. To make the model more correct some difficulties such as less info, less message networks, improvement, and actual-time are deliberated. RoboCup Rescue Simulation League has now the possibility to redone its renovation setting to permit a simple progress of control programming between rescue robot phases (both genuine and virtual). This will additionally improve its potential in favoring and stimulating the advancement of artificial intelligence (AI) answers for multi-robot backgrounds utilized in search. The RoboCup Rescue Simulation is a multi-operator regeneration for the tragedy mitigation. The RCRS server recreates tragedies which look like a city after an earthquake.

The point is to make utilization of the virtual operators so as to rescue can cover unfortunate casualties and clear complications. The Robocup Rescue Simulation System (RCRSS) is structured in multiple modules as seen in Figure 2.1.The GIS (Geographical Information System) initializes and provides the kernel with information on the location of every object in the simulation world, including roads, buildings and agents. A number of component simulators connect to the kernel, each controlling individual aspects of the environment such as fires or traffic. The final set of modules are the agents. Here is a figure of Structure and behaviour of RCRSS modules.
Kernel is the main center of all the agent. Many agent is connected with the kernel like Fire, MICS, GIS, Viewer, civilian, road blocks, and collapse. They perform according to their given task. They can report to kernel and kernel can also communicate with them. Their understanding among themselves should be at its best for the best results. Kernel is also connected to all the agents for participation like ambulance center, ambulance teams, fire station, fire brigade, police station, police force. They can communicate and perform according to the situation. We can understand the basic structure of robocup rescue simulation system by following figure, which can describe the connection among all the participants in the simulation process.

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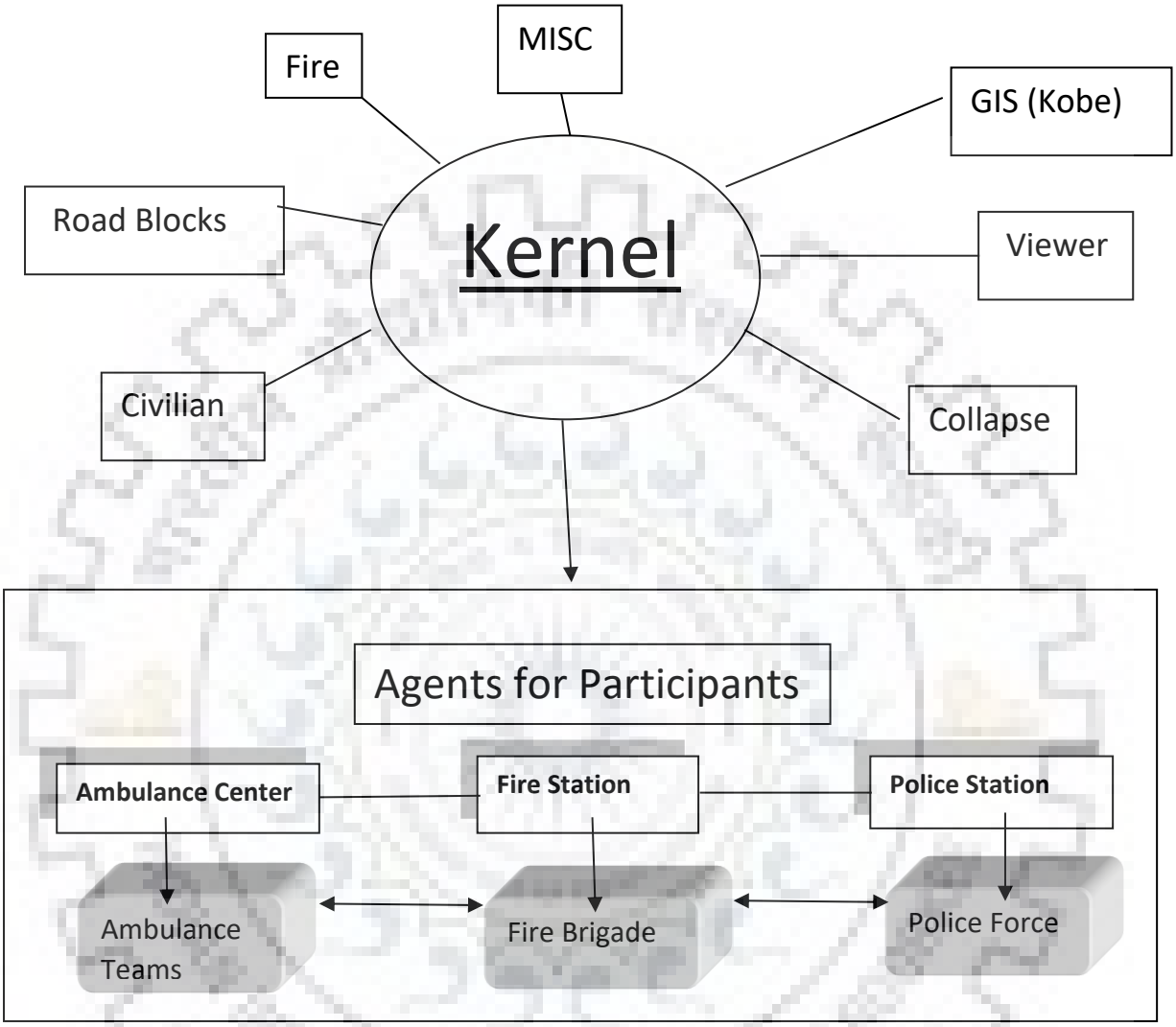

Figure 2.1 Structure of RCRSS

Every Individual in the populace is comprised of three trees, one for every one of the three self-sufficient specialist types (AT, FB, and PF). So as to battle this, little populace sizes were utilized and numerous assessments are done in parallel. In this worldview the duty of basic leadership is completely put in the focal operators. This does, be that as it may, have the characteristic advantage of organizing the majority of the non-focal operators. In the appropriated model, every individual operator is in charge of settling on its own choices dependent on the data it's given. In this model, the focal operators act just as transfers for data with the end goal that each specialist has a comparative perspective of the world. This proposal works utilizing the appropriated model, since this model all the more normally fits the structure of a low-level choice rationale. A solitary operator is contained two sections. The initial segment of the operator is worried about the capacity and correspondence of a world model. Put essentially, the specialist will recall any new or changed protests in the earth, and on the off chance that they are critical (e.g. a civilian personnel found, or a building's searing ness changed) at that point it will impart the new or changed question.

Clustering:

At First, the entire map will be separated into groups using K-means algorithm, in order to increase examine effectiveness. The cluster numbers are resolute by the no of the 3 kinds of agents correspondingly. Because of the bad message, we find if so many agent share in the same cluster, they may hunt the same structures sequentially. So, we make sure each cluster will have 2 to 4 agents allocated to it to evade searching reputably. The Definite amount is chosen by the unit which the group keeps. For instance, if some group has gas station, which means we can't stand the fire distribution in this group. So, more Fire Brigade should be allocated to this group to evade incidence and increase of fire. When agents are assigned to bands, add of the detachments that agents would take to reach their distributed gatherings should be concentrated. So, no of managers in bunches need to be definite, then each cluster select the fixed no of agent which is nearby. So the process of clustering has an important part in the robocup rescue simulation system.

2.3 Actions:

In this section we are going to talk about some actions which have been taken earlier. We can describe these action in a form of table in which direction, description and command action instruction were included. The amount of water they can carry to do so however is limited. A FB with no water must coming back to a shelter and wait to fill-up. AT agents are answerable for saving citizen from warped structures as well as transferring them to Shelters. PF agents are blamable for clearing roads by dealing with road blocks. Lastly, the Fire Station, Ambulance Centre and Police Office agents are buildings that Act as communication hubs for their respective agent teams as illustrated in Figure. All correspondence among test system and specialist modules are displayed as directions that must make a trip through the part to achieve their goal. An agent wishing to play out some activity sends an order to the part. The part at that point communicates each activity to the majority of the test systems, and those with use for the direction follow up on it and react. It was not suitable for Extinguish as regularly various targets are in range, where one might be more appealing than another. The default Move task activities to discover an unblocked way to the objective, while Move restores the straightest way regardless of bars. This was discovered advantageous amid beginning testing to make PF operators clear primary pathways.

Command	Direction	Description
Action Instructions		
For Move	agent -+ kernel	Movement of agent
To Clear	agent -+ kernel	Police Force agent clears a roadblocks
Extinguish	agent -+ kernel	Fire Brigade agent extinguishes a building with fire
For Rescue	agent -+ kernel	AT agent removes a trapped civilian from an effected building
For Load	agent -+ kernel	Ambulance Team agent loads an injured civilian for transportation
For Unload	agent -+ kernel	Ambulance Team agent unloads a carried injured civilian
For Saying	agent -+ kernel	Agent communicates to any other nearby agents
For Telling	agent -+ kernel	Agent communicates via transmission each other
Sensory Info		
For See	kernel -+ agent	Visual information of nearby agent
For Hear	kernel -+ agent	Auditory information of nearby agent
For Listen	kernel -+ agent	N ·an mission from another agent

Table 2.1: List of agent instructions in the RCRSS

Agents, excluding the centers, have one preliminary aggregate of health related points, which may decline if they feel like hurt or if they visit private a burning structures. They can be suppressed, in which case they are confined and cannot transfer until they are unburied by an AT. We can recognise Agents' capabilities by their type like:

- Civilian Sense (Hear, Move, and Say)
- Ambulance Team Sense (Hear, Move, Say, Tell, Rescue, Load, and Unload)
- Fire Brigade Sense, (Hear, Move, Say, Tell, Extinguish)
- Police Force Sense, (Hear, Move, Say, Tell, Clear , Center Hear, Say, Tell)

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The main flawless data every operator has about nature is the guide of the city, as it is known since the start and it is static. So as to see current data about the earth, the operators have the capacity sense, through which the bit sends data about the environment, which incorporate current circumstances of structures, streets and different specialists that are in the recognition sweep of the specialist. The other way operators can find data's about the world is through voice messages sent by different specialists.

To move around, specialists need to send a move direction to the piece. They have a limited speed and might be not able go through some course if the street is blocked or if there is another operator obstructing the way. It is conceivable to move around streets and structures, entering and leaving the last by their doors. The Ambulance Teams are fit for safeguarding exploited people (Rescue), stacking them into the emergency vehicle (Load) and emptying them at the asylums (Unload). Fire Brigades have capacity for stifle fires, while Police Forces can clear blocked streets (Clear). There is one critical distinction between Police Forces, Fire Brigades and Ambulances: while it has no effect to have more than one Police Force to clean the equivalent blocked street, this isn't the situation for the other two kinds of operators. A fire will be doused quicker if more Fire Brigades are following up on it, and exploited people will be saved quicker if more Ambulance Teams are dispensed to their safeguard. The main restriction of the Ambulance Team is that it can't convey more than one unfortunate casualty at the same time.

Environment

The earth spoke to in RoboCup Rescue test system is made out of various items. The most imperative articles in the recreation are: structures, streets, blockages, shelters and people. The structures have a few properties, for example, region, building material, fire blaze and brokenness. All these data are utilized by the test system to ascertain the fire spread and the building's breakdown. The building material characterizes how quick the building will consume and how it will fall. The blaze is an esteem which shows how solid the fire is, extending from 0 to 7, where 0 demonstrates the building isn't ablaze and 7 demonstrates the building is totally singed. The brokenness property demonstrates how demolished the building is and that it is so liable to disintegrate. The streets are the elements used to move along the guide. A portion of their properties are length, number of paths and blockages. On the off chance that a street has no free paths, for example the paths are obstructed by blockages or by different operators stopped in the way, it is beyond the realm of imagination to expect to move along it. Blockages are substances which square streets, making the paths they are blocking obstructed. They have the property of fix cost, which characterizes that it is so difficult to evacuate the blockage. Blockages are made by crumbled structures and they must be cleared by police constrain. Shelters are an extraordinary sort of building that keep the safeguarded regular folks and give water to flame detachment specialists. The shelter can't get ablaze and don't fall. People are humanoid operators, which connect with the earth.

There are two kinds of voice messages specialists can utilize: tell and state. The tell type sends message through a radio to all operators of a similar sort of the sender and to its inside, in the event that it is a detachment, and to every one of its specialists and to alternate focuses if the sender is a middle. The state type sends message to all specialists in a characterized span from the sender, the default range utilized in the challenge is in restricted meters. Voice messages can have a most extreme size of 256 bytes, if an operator attempts to communicate something specific greater than that the message gets dropped. There is likewise a confinement on the measure of messages one specialist can send or get at each turn. This limit is four gotten and four sent messages for unit operators and 2n got and 2n sent messages for focuses, where n is the measure of company specialists the inside has. The main data accessible to choose to hear the message or not is the sender id. We can comprehend the arrangement of message channel by this figure in which procedure of hearing is appeared to us .they can get and evacuate messages effortlessly. In correspondence watching messages on time is a major test. This can help effetely in our work in future.

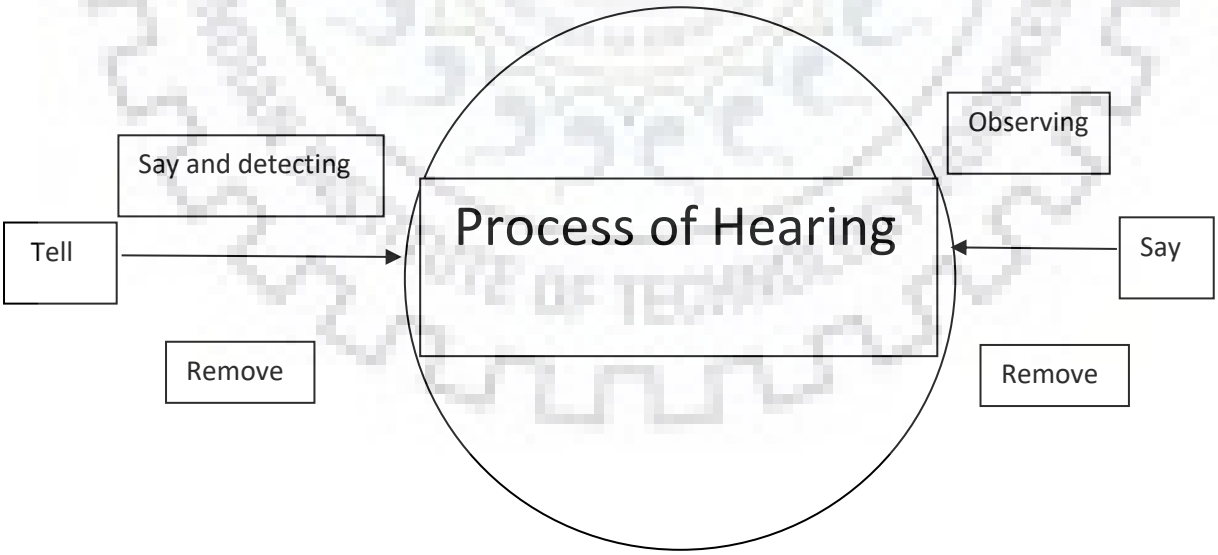
2.4 Agents' Features, Capabilities and related work:

The agents in the RoboCup Rescue Agent Simulation are divided in two main types: rescue agents and victims (civilians). The rescue agents are classified into moving (platoon) agents and fixed (center) agents. The agents are answerable for accomplishment some activities in the atmosphere like reimbursement roads, saving people and dousing fires. They are sectioned into 3 kinds: AT, FB and PF. AT are the agents answerable for saving citizens. The ambulances can save anyone, not only civilians, but their core aim is to take civilians safely to the refuge. Fire Brigades are the agents responsible for extinguishing fires, consequently their exclusive capability is fire smother. To refill their water tanks the fire brigades need to go to a refuge, in which a certain amount of water is refilled at each turn. Police Forces are the agents responsible for clearing blocked roads. Their exclusive capability is clearing roads. If a road is blocked, agents cannot cross it, so they may get stuck or may need to take a much longer route to get to their destination. To clear a blockage the police force needs to stay close to the blockage and send clear commands to the kernel, the time taken to clear a blockage varies, depending on the repair cost of the blockage. The rescue agents interaction with the simulator is performed through the simulator kernel, and each agent runs as a separated process to the sub-simulators, which also run as independent processes.

Messages:

There are two types of voice messages agents can use: tell and say. The tell type sends message through a radio to all agents of the same kind of the sender and to its center, if it is a platoon, and to all its agents and to the other centers if the sender is a center. The say type sends message to all agents in a defined radius from the sender, the default radius used in the competition is in limited meters. Voice messages can have a maximum size of 256 bytes, if an agent tries to send a message bigger than that the message gets dropped. There is also a limitation on the amount of messages one agent can send or receive at each turn. This limit is four received and four sent messages for platoon agents and 2n received and 2n sent messages for centers, where n is the amount of platoon agents the center has. The only information available to decide to hear the message or not is the sender id. We can understand the system of message filter by this figure in which process of hearing is shown to us .they can get and remove messages easily. In communication observing messages on time is a big challenge. This can help effetely in our work in future.

Figure 2.2 the message filter:



Planning:

It is viewed as fractional in light of the fact that the operators don't have all the natural data accessible so as to settle on the best choice. Then again, it is worldwide on the grounds that the specialists can trade and acquire data through the focuses which merges nature data from every one of the operators. At first, our methodology thinks about that unit specialists can act autonomously from their focuses, in any case they are restricted to act dependent on all alone neighbourhood data or on data got from other close operators. This essential technique was characterized to deal with circumstances in which either the company operators can't contact their focuses or the focuses are not accessible at the reproduction. Be that as it may, since much of the time the correspondence to the focuses is accessible, our other correspondence methodology underlines the data stream concerning unfortunate casualties, consuming structures and blockages from unit operators to their middle and the other way around. In such situation, in the start of the recreation the unit operators walk arbitrarily so as to give data about the earth to their middle. At the point when the activity is done, they refresh their focuses with the present data. In the succession, if the company specialists does not have or can't detect some other circumstance to act, they ask for again data to their focuses and the cycle restarts. Regardless of whether the focuses can't specifically organize the unit operators, they can play out a kind of coordination while giving data to them

The Ambulance Center operator, for example, can utilize the data about the rest of the life of the people in question, the harm and separation to decide the need for Ambulance Teams save. Then again, the Police Office Center operator can consider the save specialist types to decide the cleaning blockage need. If we want to save our time in the rescue operation then we have to make a path planning. So we are going to discuss about subsequent partial differential equation in

Path planning:

Arrangement of paths plays a vital role for all agents. If agents can select a short way, they are going to save much time on road and they can have more time on their work for rescue. A-star search is the best commonly recognized best-first search algorithm, which we have intended for so many times. It estimates the complete charge from the first knot to the final goal. Which is set by the subsequent partial differential equation [8].

$$f = g(n) + h(n)$$

g (n) = g(n) is the cost it took from the first knot to get the knot n.

h (n) = h(n) is the cost from the node n to reach the goal node.

In this stage, we estimates the distance of two knot as charge. From the global Information, agent can look for the shortest way by using A-star search algorithm. This algorithm is superb when we trial without road blocks. Though, because of road blocks, agents typically be blocked from everywhere. In order to answer this problematic situations, we implement a general technique to review whether the road is drivable. We have to judge whether the edge is jammed that agent can go through. If edge is jammed, we can judge the road is unpassable. By this technique, agent can escape road blocks. Still, it is a disappointment that this technique is wrong.

Occasionally, agents will take a tutorial though they can clear roads. The Ambulance Center agent, for instance, can use the information about the remaining life of the victims, the damage and distance to determine the priority for Ambulance Teams rescue. On the other hand, the Police Office Center agent can consider the rescue agent types to determine the cleaning blockage priority. This formula is driven by subsequent partial differential equation and this is very helpful in path planning for robocup rescue simulation system. We can save our precious time using that formula. We are going to understand the related work regarding our research topic in next segments.

Related Work

As the applications and growth of the trainer, many effort has been done by scholars in the zones of direction and charge distribution.

There are 3 methods to resolve the management issue:

(1) joint modification (distributed),

(2) Straight direction (integrated)

(3) Normalization.

Research also designates a circulated tool which practices limited intellectual. Distribution of assets and responsibilities in multi-agent arrangements and the use of communication to increase enactment are well calculated topics. Next their classification, our area of awareness attentions on separate tasks, which are not divisible but sharable, are non-stable, and are preservative.In the simulator, agents play own roles with their actions so that they can perform:

Ambulances looks for injured citizens, save them and take them to a protection.

Fire bridge looks for extinguish fire and their water tanks as needed.

If we talk about standard domain overview then the standard space gave the stage is an urban tremor situation. A remarkable earthquake tremor has struck a city and the different crisis administrations are controlled by specialists. Specialist activities three parts of the crisis administrations are demonstrated: fire units, cops and ambulances. These specialists are basically in charge of, individually, quenching fires, clearing blocked streets also, rescuing caught or harmed regular folks. Operators can issue directions to the recreation server to move, smother a fire, clear a blocked street, protect, stack or empty a citizens personnel or make an impression on another operator. Correspondence With the radio channel model of correspondence it is workable for specialists to pick their own correspondence structure, perhaps notwithstanding transforming it on the fly. The stage gives a rich, complex condition, an urban quake situation, that features a few open issues in multi-operator inquire about.

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CHAPTER 3: Structures for RoboCup Rescue

3.1 Main Objectives of this Thesis

The core aim of the competition is to improve smart classifications to control the AT, FB, and PF agents in the RCRSS. The key role of this theory is to excel at this detached using Programming by aiming on growing the behaviours essential. This thesis focuses not just on the ability of the agents to achieve high scores (as measured by the simulation system), but also on the specific strengths and weaknesses of individual behaviours .Since the overall task of performing well according to the RCRSS default scoring equation is a mind boggling one including various unique targets and imperatives, it is un suit ready to assess the whole outcome on a triumph or bomb basis. Ideally, it is trusted that operators will be advanced to equal the capability of human-made operators from past RCR competitions.

The goal of this work will be to assess the built up framework's capacity to develop practices competent tackling person sub problems. In this mode this suggestion centers mostly on the appropriateness or on the other hand working performs, committing the rest of applies to constant and upcoming work. For instance, an AT ought to be fit for finding a caught regular citizen, liberating them, stacking them, transporting them to a shelter and at that point emptying them. Before the finish of advancement in this class of practices it is trusted that specialists will be compelling and effective at the execution of their center assignments. Furthermore, it is regular that there will be a reduction in performs that are either problematic or senseless.

The core insides of this editorial are mentioned as follows:

1) We can use A-star search algorithm for helping our agents find the shortest way.

2) The main policy of Police Forces.

3) The core approach of ambulance team.

4) The scheme of Fire Brigade.

Circumstances:

There are two principle wellsprings of natural data in this dialect, coming from two primary sorts of data. Data about articles in nature are put away in and got to as arrangements of explicit kinds. Data about conditions or conditions of the earth are questioned by means of capacities that arrival Boolean qualities. The rundown natives are predominantly involved full accumulations of single question types, for example, all-Buildings or all Blockade. A portion of these accumulations are of conventional protests, for example, structures or streets, while others are accumulations of increasingly explicit subsets, for example, fires (structures that are consuming) , or bars (streets that are blocked). This was a disentanglement given to the GP dialect to improve resolvability.

Refiners:

In order to make use of the large gatherings of environmental objects, the agents are delivered with a wide array of type-specific list-refining primitives. These primitives are a simple way for the agent to reduce tile size of probable targets based on very exact properties of the targets. There is however, a large potential for error while using these primitives as multiple overlying uses can either be Terminated or simply empty out the list.

Task Assignment:

Before a FB specialist moves to smother a fire, or before an AT operator moves to protect a regular citizen, it should settle on a canny choice on which fire or civilian personnel is the most critical or proficient to follow up on. Accordingly, a legitimate harmony between the designation of investigation and target activity is a fundamental undertaking task issue in this space. Compelling prioritization of errands is the thing that raises the triumphant groups of past RCR rivalries over the rest. This type of strategizing conduct is plainly a stage over the activity choice targets of the past class. The desire here is that people developed to play out the less complex undertakings of the past class will be more qualified for advancement of more confused practices than people with no earlier adjustment. The errand task conduct class is separated into three stages.

Participation:

The third conduct instrument envelops a few types of participation. Specialists of various groups must collaborate so as to accomplish common advantages in their individual goals. Most strikingly, PF specialists should clear detours permitting FB and AT operators to achieve their planned targets. Additionally, regular people caught in consuming structures will take more harm than those caught in structures that are not lit, so collaboration is required between a wide ranges of operators. Moreover, specialists of a similar sort should frequently participate. Most assignments that operators perform can be rushed by the utilization of different specialists acting on the double. Numerous targets may likewise profit by the scattering of operators to build the aggregate zone of mindfulness and number of undertakings being finished. In this way a parity of these two variations of collaboration might be required. Participation in this theory is viewed as the social occasion of information by one operator about another specialist and consequent utilization of that learning to manage their very own activities. Therefore the natives which make up the collaboration step have the regular ascribe of offering access to data about different operators. Since it isn't obvious from the start whether collaboration is a troublesome conduct to develop or whether its belongings will be commonly valuable, tests including participation will be considered as an evade at everybody of the recently referenced advancement steps. Along these lines agreeable practices can be assessed as far as their commonness in the populace and their impact on the subsequent score at each phase of development.

Communication:

Control and Coordination

Management is necessary to reply through proper sorts and number of agents to define the obtainability of agents. Agents connect amid each another and with their centers to let another identify of their existing job, their position and when the task is predictable to be completed. So management also plays an important and unique role in planning.

Broadcasting of info:

In a calamity situation, whole info isn't obtainable to the saviours when they first react to a condition. Generally, the one data they have is that a tragedy has hit a region. They have no data concerning the measure of the tragedy, or the quantity of persons stuck and injured, or the range of destruction to the assets. So communication become very important segment in these type of situations. RoboCup Rescue Simulator does not notify the agents of an adversity condition. In its place, the agents have to watch the zone by themselves looking for goals like road blocks, confined citizens and structures on fire. An agent can intellect any type of aim. For instance, if a police agent intellects a fire, it refers a communication to the fire brigade concerning the site of fire. So we can say that interconnection has a unique character in circulating info related the site and exploit it in hand. In a real disaster, it is not constantly potential to connect because there may be some complications with the message kit or the arrangement.

Connection during RoboCup Rescue Simulation:

Communications have to be specific, interstellar able and must not be faked for communication to be operative. The communication instruction in RCRSS are detailed further.

1. Total of 10 channels accessible for message. They are linked to radio frequencies on which agents can interconnect with each other.

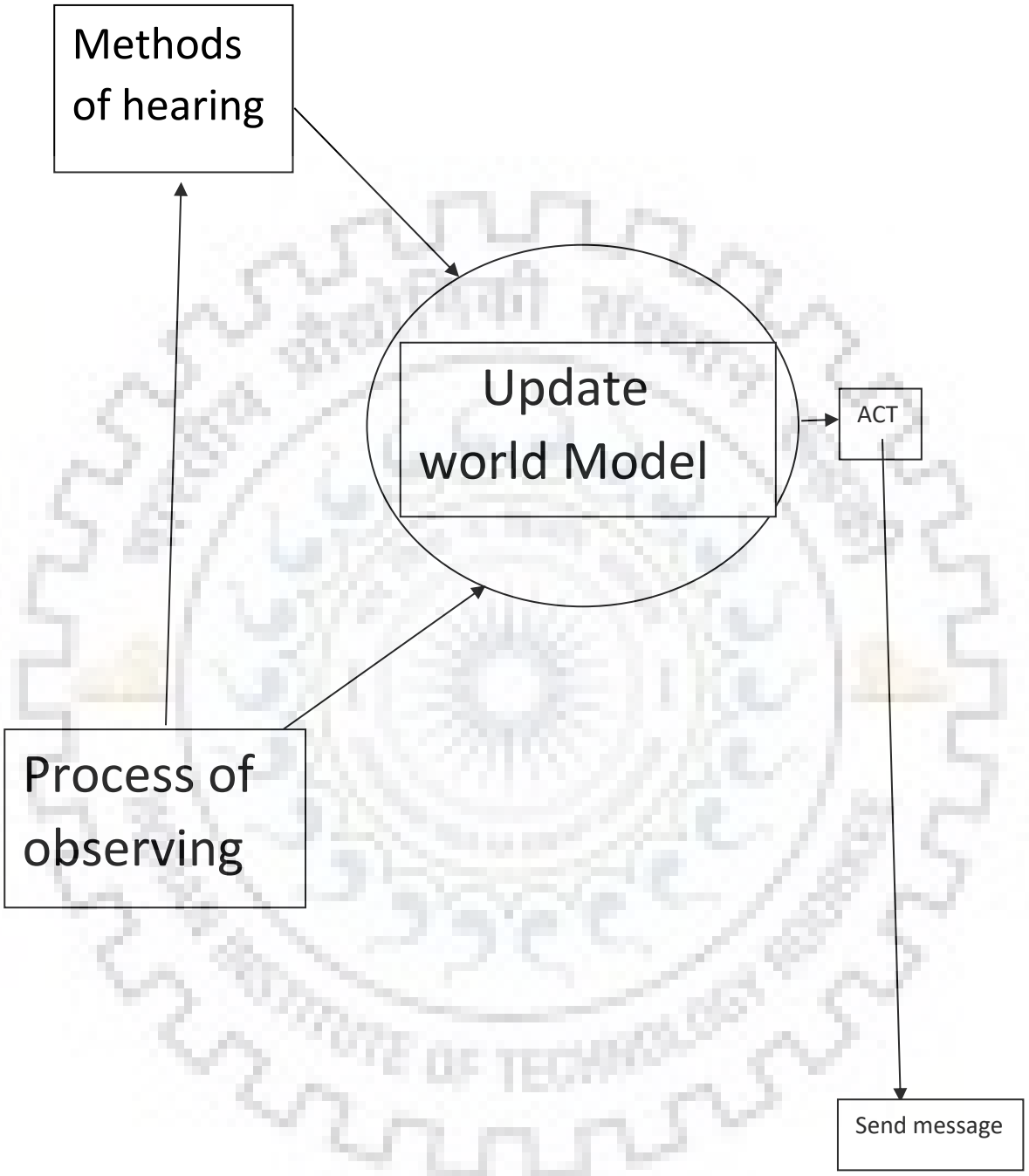
2. Each agent must record the stations it proposes to send or receive announcement on with the kernel.

3. Messages can only be received by only those agents who have not exceeded their receive count can only be receive messages.

4. Max size of a message is 256 bytes.

5. The number of messages per cycle is restricted as follows: Agents can send and receive 5 messages per cycle. Centre agents can send 3 and receive 3.

The Final work procedure of agents:



3.3 Our Strategies and agents:

In this section, Strategy related each kind of saving agent (Fire Brigade Agent, Policy Force Agent and Ambulance Team) is described in more detail. Reliable info about the simulated environment is vital for efficient action planning. In the context of RoboCup saving model, the information mentioned are those related to blocked roads, victims and buildings on fire.

Commonly, the primacy of arrangement is

(1) AT through sufferers,

(2) AT lacking sufferers

(3) FB.

However, as agents have limited sensing with communication competences, info allocation is not trivial, as it is wanted to deal with these limitations. So we decided to use a strategy of centralizing info, however, keeping the rescue agent autonomous to perform its tasks if it cannot contact its center. The clue is to grip a world-wide and integrated info source where all applicable data sensed by the agents. This info is conveyed by agents, and then administered and reorganised to all the agents whenever demanded. Subsequent subdivision delivers a short explanation of every type of saving agent applied in work. Since some of agents have partial infrastructures they can't manage professionally. They procedure with their awareness of the initial map and allocate themselves to particular areas to discover, confirming that there is partial repetition of work among them. They trust on the centers to offer them with a lot of detailed info on awaiting responsibilities. We can express the main root scheme of agents.

Police Agents:

While answering to necessities, the police agents save their earlier way and return to the portion of the trip they were on after the demanded block roads to is cleared. This confirms that the agents thorough their trip and appear to emergency requirements in a suitable method. Clearance of paths to shelters is fundamental, as FB want to reach shelters to fill-up their water tanks and AT need to have short paths to reach the shelter when bringing citizen. Henceforth, the first independent aim of the PF is to clear a road to the shelters. The PF' common plan involves of reimbursement of the neighboring road blocks they have info of, if they know of any and they have not established any orders from the Police Office center. While clearing a road block, the PF send say messages to advice nearby PF the block road is previously actuality cleared.

In case the Police Force has received any orders from the Police Office, it stops doing whatever it is doing and moves to the target received from its center, clearing blockages on the way if needed. If PF don't recognize of roadblocks and it has not established command from the Police Office center, then it requests the Police Office for instructions and, while waiting for the response, moves randomly. The Police Office Center receives info related road blocks from other centers and shows it to the PF agents when requested. So as to retain the agents good up-to-date and dependable info must be obtainable for them and the best info basis in this situation are the agents own.

4.2 Ambulance Agents:

Ambulance agents are in charge for rescue citizens those are damaged or stuck. Citizens have circumstances decline over time, hence they have to be situated and saved in less time. Gathering information and saving citizens are the main aim of these agents. Management with other ambulances also helps in having a good speed in the process. As the info offered to each ambulance is deficient to define which citizens to save first. Police and fire agents help by discovering structures when their own works are over. This boost the speed exploration development and permits the ambulances to focus on saving. Civilians may die if not rescued fast enough, hence, efficiency is vital. Therefore, the strategy adopted by Ambulance Teams has to be carefully planned. The strategy employed by our Ambulance Teams has some phases. At starting of the model, they look for accidentally for sufferers. When a sufferer is found, the AT transfers to that site and starts the saving operation. Firstly, it analyses if the building is on fire, then if the building is on fire unfortunately the ambulance can do nothing, since it can die with the fire as well. In this case, the Ambulance Team informs its center about the fire which may inform the Fire Station Center, since the Ambulance Team cannot communicate directly to other centers.

Nevertheless, if the building is not on fire then the Ambulance Team checks if the civilian is buried, in case it is, the Ambulance Team starts the unburying process. Later the sufferer has been saved from fire the AT preferences it up and begin transferring it to the nearby shelter. After they reach at the shelter, the citizen is dropped and AT begin to look for alternative sufferer. The dependability of the info about citizens is reserved into description when critical which citizen to save. Hereafter, if the info is very much old, centered on a beginning of time, then the AT pay no attention to it, since the info is deliberated not trustworthy.

Fire Brigade Agents:

FB and their station are having a role in authority for attainment of fire in control. The range of fire be determined by speed of wind and direction of wind. Because of fire, buildings get smashed and breakdown subsequent in road blocks. Moreover, fire can outcome in citizen death. A serious duty of the fire agents is to keep an exact picture of the fire sites and strengths through the city. All agents of any type can report to the Fire Station for any building them intellect is on fire, along with the time they revealed it. The Fire Station retains all buildings on fire, and informs each building's fire force as new facts are collected. At the beginning of simulation, RCRSS starts fire at multiple locations in the city which then spreads to other close buildings. Because of fire, structures get damaged and downfall subsequent in road blocks. Moreover, fire can outcome in citizen loss and damage. Fire has a straight effect on the score of the simulation. Fire Station manager nonstop regulates where the site with some more fire plugs is depend on the fire attentions info established from the agents and readdresses more FB to that place since it has many more probable sufferers and greater no of structures piping hot. FB have to find the structures and places where fire is increasing and smother it as soon as possible. The agents are the most valuable when they are capable to reach the location of tragedy soon. Fire brigades have to manage with the police agents to get the entrance road blocks cleared.

When model starts, the FB look for fire places accidentally. After discovering a spot of fire, they go for that site to smother the fire. In the event that they are equipped for being there inside the arrangement to start dowsing the fire, they do as such till whichever the fire is covered or they run feel powerless because of water. In that specific case they are not ready to make it in achieve the end inside an all-around characterized time, the present target is estimated blocked off and is disregarded, and thus, the operator begins the find for another objective and mission. At the point when the structure that the FB is coordinating has its fire covered or wounds totally the objective is revise to invalid and the searching for sufferers system again begins. At the point when an operator absence of water, it attempts to look through a path to the adjacent asylum to top off its tank, denied of moving its objective development. When the FB is top off, it endeavors to look through a route back to its last plan to continue its fire battling. This imply specialists are resolved with their points, as they don't change its present point until the point that it is trusted hard to be there or is never again a compelling point. Each FB can secure all unique sort of hydrants and safe houses in the guide.

Initially, the FB hunts for all presented choices to fill water, if nearest water option is a shelter, the agent heads for it immediately. Else, if shelter is too far-off from FB, the FB looks for the closest obtainable hydrant. FB heading for a hydrant must organize together by acquiring the lock to this hydrant. The lock is given to the agent nearest to the hydrant. A fire location may not be reachable especially due to the dropping rubbish from the fiery structure and the securities where the fire brigades fill-up water may not be available because of road blocks. Even when fire starts at many sites, duty sharing becomes a problem and Route arrangement has to be done to reach the sites of fire and saving teams.

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Chapter 4 Experiments and results

If we talk about implementations so in order to experiment, our rescue team needed to use concept. Generally Act: a normal action done by a manager **(**Fill-up; Move to/from citizen; Load Citizen; Transfer to shelter; Drop Citizen), Report: filling a Fire Brigade tanker in a shelter, Request: established of movements done by an agent. Some Examples: Charge: saving citizen; System: fixed of jobs done by 1 or more agents recycled to crack a specific ground difficult in a precise way. Example: System: Clear important roads by ordering the important roads; Responsibilities: Each selected road or set of roads is allocated to an exact Police agent, and after that Police force agents clear the roads and many arrangements were used: Particular extra information of the saving system is worthwhile to entirely recognise the policy.

We can sense some outcomes like As a result of some communication and administration, our agents are skilled to reach all the locations where is fire. This demonstrates the significance of taking effective Fire agents. We also detected and can assume that in some environments our agents can't search standby ways and got blocked. If we talk about Proportional exploration then the main aim of these trials was to associate the score gained when using the model agents, which were delivered with the stage. So as to run the tests it was measured 3 kinds of agents (Fire Brigade (FB), Police Force (PF), and Ambulance Team (AT)) along with totally responsibilities (dousing fire, clearing roads, and saving citizens). Additionally, it was reflected that the presence of one accessible center of every kind (Fire Station (FS), Police Office (PO) and Ambulance Center (AC)).

Chapter 5 Conclusions and Future Work

Conclusion:

Fire Brigades have to search the structures and places where fire is increasing and smother it as soon as possible. The agents are the most valuable when they are capable to reach the location of tragedy soon. Fire brigades have to manage with the police agents to get the entrance road blocks cleared. There were some Problems tackled by Fire Brigade Agents. Therefore, we can guesstimates the problems that are provoked by the FB:

1. The agents are unaware about the locations of fire and have to see the sites as the model works.

2. Most important work is time utilizations because we have to save people from fire, but not getting satisfactory results.

3. A fire location may not be reachable especially due to the dropping rubbish from the fiery structure.

4. The securities where the fire brigades fill-up water may not be available because of road blocks.

5. When fire starts at many sites, duty sharing becomes a problem.

6. Route arrangement has to be done to reach the sites of fire and saving teams.

Future Work:

There are various analyses have been begun and it will be finished as continuous and future work. As future work, we have intention to improve the strategy presented in order to subdivide the agents into specific parts of the map depending on the number of fire spots and civilians identified. We can use methods for the programmed formation of complex arrangements. For example, control of independent specialists. Results in international competitions for both the areas tested, proved the success of the layer. Strategies are easily developed through the use of a very user-friendly graphical tool. By using a frequently improved, open source, editor as its base, the developed graphical tool can take advantages of its innovations. In the future, further development of the graphical tool is expected, mostly on the source code generator. These improvements will able a more comprehensive use of the calculated sheet in the setting of RoboCup and in other supportive areas. Thus, we can plan to use the coordination intentionally covered with so many ways and constructed by the tool of graphical systems in future.

Bibliography

[1] https://en.wikipedia.org/wiki/RoboCup#cite_note-6

[2]https://www.researchgate.net/figure/A-typical-RoboCup-Rescue-Simulation-scenario_fig1_264466150

[3]https://www.semanticscholar.org/paper/Hierarchical-Decision-Theoretic-Planning-for-Rescue-Traichioiu/7611bf32dcf9cb9f4d8227a7fcce3e3623a00cab/figure/1

[4]http://ai.jpl.nasa.gov/public/home/bclement/icaps05-workshop-map.html

[5]. Tadokoro S, Kitano H, Takahashi T, Noda I, Matsubara H,Shinjou A, Koto T, Takeuchi I, Takahashi H, Matsuno F,Hatayama M, Nobe J, Shimada S (2000) The RoboCup-Rescue project: a robotic approach to the disaster mitigation problem. In: Proceedings of the IEEE Int. Conf. on robotics and automation (ICRA)

[6] Kitano H, Tadokoro S (2001) A grand challenge for multiagent and intelligent systems. AI Mag 22:39–52

[7] Murphy RR, Tadokoro S, Nardi D, Jacoff A, Fiorini P, Choset H, Erkmen AM (2008) Search and rescue robotics. In: Springer handbook of robotics. Springer, Berlin, pp 1151–1173 (ISBN

978-3-540-30301-5)

[8] https://en.wikipedia.org/wiki/Partial_differential_equation

[9] https://en.wikipedia.org/wiki/Great_Hanshin_earthquake