



Design and Implementation of Swarm Robotics for Load Controlling Applications

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Abstract - The present era, where technology is making its way to the zenith, there is no requirement for human to do every small aspect that helps him support this survival. There is no requirement for humans the lift heavy loads and to meet up their consequences such as backbone injuries etc..., It is these small functionalities that can be done by the extra-terrestrials namely Robots. Swarm Robots is a developing technology. The word "Swarm" refers to working as a group. We have four robots in which there is a master and three other robots. The robots are generally classified into two namely i) Explorer Robots and ii) Carrier Robots. The explorer robots first traverse through the entire path from the source to the destination. They send the information about the terrain to the carrier robots and they act accordingly. Thus the slave works according to the commands of the master. They are designed in such a way to undergo location even on rough terrains. Thus the tasks get accomplished easily in a much more effective way. particular object. So this increases the security along with reducing the burden.

Key Words – Swarm Robots, Explorer Robots, Carrier Robots, Master Robots, Slave Robots, Rough Terrains.

1. INTRODUCTION

The life of each human has changed radically over 10 years. In the present situation it is unrealistic for a human to do insignificant works like auto-activating a material starting with one place then onto the next or from source to goal . In spots like ventures where lifting overwhelming burdens is obligatory, there is no need that these movement exercises need to conveyed by people. In such cases our robots can prove to be useful. The fundamental point of our paper is to put the human at his dial down doing the work of velocity.

This separated from decreasing the weight of human, it additionally lessens the danger post by a human of treatment of any



Fig-1: Group of Robots

Our paper advances its attention on the way that we suggest two sorts of robots. The Robot of first kind is Explorer Robot, which for the most part center the exercises of a pioneer. The second sort of Robot is the transporter Robot, which takes after the summons of the Explorer Robot. In different terms an Explorer Robot can be called as a Master and the Carrier Robot can be called as Slave.

Subsequently the Swarm Robots take a shot at Master Slave Concept like the province of an insect or the honey bees in a bee sanctuary. This makes for the Swarm Intelligence.

These Swarm Robots have the qualities of Sturdiness, versatility, adequacy in operation, adaptation to internal failure, flexibility to the territory etc...,

Aside from load sharing they are intended for different applications like firefighting, horticulture and furthermore information sharing. It prevents over-exploitation of resources. Apart from load sharing they are designed for other applications like firefighting, agriculture and also data sharing.

2. BIOLOGICAL BASIS

The word Swarm as advised before symbolizes the movement to fill in as gathering. In an organic viewpoint the idea of swarm was gotten from the formic [20]. The formic by and large speaks to the ants. A gathering of ants are called Swarm. From the most minimal point in the scientific categorization of arrangement, each living being both unicellular and multi-cell works in gatherings. So this is the primary starting point for the idea of swarm apply autonomy.

These ants fill in as a gathering basically to assemble sustenance and furthermore shield themselves from the predators. We by and large realize that ants all work under a typical chief who is called Queen Ant. The ruler insect is the one that summons all other laborer ants.



Fig-2: Swarm of Ants

The nonappearance of the ruler subterranean insect would stop the work of all the laborer ants . So it is on the whole correct to reason that the specialist ants are inert with the ruler subterranean insect. They would have a mayday without the ruler; these specialist ants have no reasoning capacity. So a Queen is required to keep them dynamic.



Fig-3: Swarm of Bees

The same is pertinent for a colony. The honey bees don't act without the summon of the ruler honey bee. So like a subterranean insect state an apiary has the need to have a ruler.

We utilize this idea of Swarm in ants and the swarm of honey bees as the principle stream on the scenery.

3. THE SWARM CONCEPT

3.1 Pioneering of the Swarm Robots

The idea of Swarm Robots will loan an extraordinary assistance later on, if not soon at any rate in the days to continue. So this has its own particular favorable circumstances. Here we have four robots where there will be an ace and three slaves . The work of the slave is to fulfill the desires of the ace. So we have each of the four robots work for the satisfaction of an undertaking and thus the errand gets finished in time without the utilization of surplus measure of assets. This is the key resource for the advancement of Swarm Robots.

The next thing we come to know is that most robots are Omni-directional (i.e.,) they have the ability to move in all directions. This is of a major advantage because they have the ability to access remote location which is mainly conquered by their tolerability to any climatic changes and can encounter any wear and tear [26].

This is a technique that also reduces the time as there are various robots searching in various locations the span keeps on increasing.

3.2 The concept of master and slave

The block diagram of Swarm robotics in load sharing is picturized in the following block diagram where we have Raspberry Pi 2 which is the core and the brain of the concept. It is overlooked over Atmel because of its processing speed i.e., it has the ability to operate more instructions at a time simultaneously. It is also attached with cameras and hence makes the concept of image processing possible. The ZigBee module is just used as a means of communication.

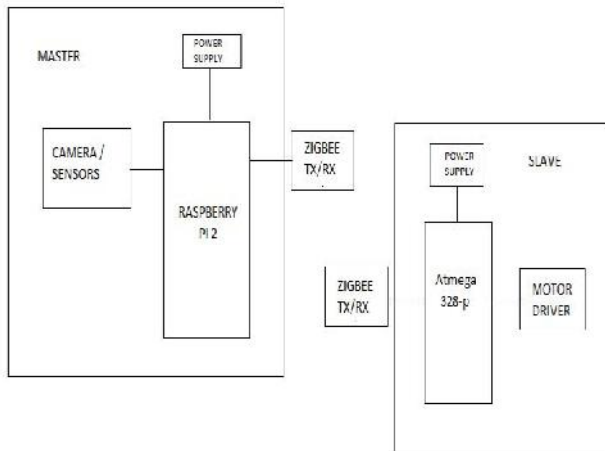


Fig-4: Block Diagram of Master and Slave

3.3 Alignment of Multiple self-governing robots

As discussed above these robots have the ability to act on their own and don't necessarily require the attention of humans for its operation.

The main focus of having this is to minimize the extravagance in the resources being used and to reduce all these. This is a valid reason for the concept of Swarm Robots as this focuses the main concept of this paper.

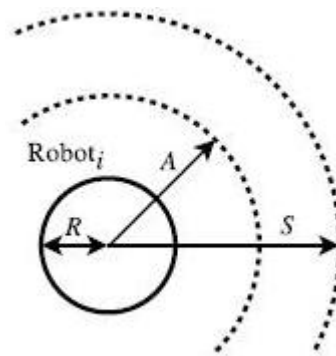


Fig-5: Essential Parameters

The Swarm Robots are generally said to follow line of Sight means of communication. This mainly helps in the process to a greater extent.

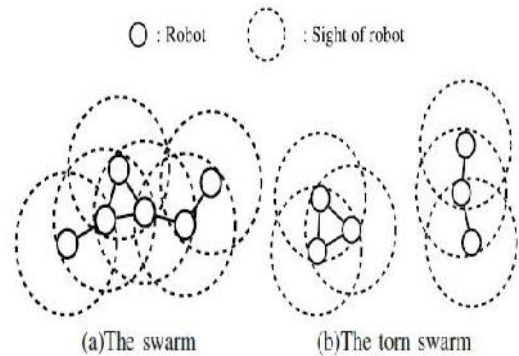


Fig-6: Swarm Structure for Communication

3.4 The phases of Transportation

There are four trivial phases of transformation our swarm Concept. In this concept we have the Master robot going in search of the designation and then giving commands for the slave robots about the location of the task for accomplishment. Then the slave robots follow the commands of the master and act accordingly. another with ease. In case of any hurdle in the path the explorer robots instructs the carrier robots in such a way that its path gets alternated and they are driven to follow a new path.

In Phase (IV) we have the object being carried by the carrier robots from its source to its destination through all the hardships.

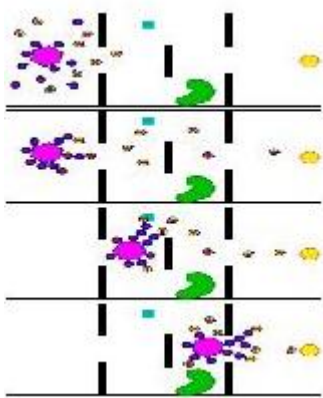


Fig-7: Phases of Transportation

From the above it is evident that there are numerous robots, but here we are taking into consideration only four robots. Out of these four as mentioned above only one will act as a master and the remaining will all act as slaves. Thus the master slave concept is also experimented. We have four phases of the load being carried from source to destination. In Phase (I) we have the diagrammatic representation of the object at the source. We also have numerous robots surrounding the object. In Phase (II) the diagrammatic representation depicts numerous explorer robots that lead to the preferred destination. It also indicates the carrier robots are about to carry the object to its destination. In Phase (III) illustrates a path has been determined by the explorer robots and the carrier robots follow this path and lead to the destination along with the object to be carried. The explorer robot gives ever obstacle in its path to its destination and hence the object is moved from one end to

3.5 Communication of the Swarm

In general the word swarm means working as a group. In this we visualize the swarm robots that have to work as a group and for accomplishing this they are supposed to work as a group. In order to work in a group these robots must have intercommunication among them.

To accomplish this we use ZigBee module as the communication device between them. In the present era with the development in technology the zigbee has developed to greater heights in the field of communication and is looked upon over other means of communication.



Fig-8: ZigBee Module

The use of ZigBee reduces the amount of space the module occupies on the device and is also easily accessible.

4. PATTERN FORMATION

There are two types of pattern formation in Swarm robotics which include Strip formation and chain formation. Based on the necessity anyone can be implemented. The patterns include i) Chain formation ii) Strip formation.

4.1 Chain Formation

In chain formation the load is carried by a chain of robots [1]. This is mainly followed when the dimension of the load is smaller by length (i.e...) they are carried by virtue of their breath [11].

It sometimes accounts for improper utilization of resources because the robot in some cases in the necessity to accomplish the given task even before the stipulated time speeds up the work process by involving an additional robot [27] [10].

It can be reduced to the maximum extent, but when there arises a necessity to complete the given task well before this can come in handy [2].

4.2 Strip Formation

Strip formation is generally applied in cases where the swarm undergoes a necessity to push a load which is dimensionally longer in its length than it breath [11]. The strip of robots help very much in the concept of load sharing because the weight of the load is calculated and then the load is being pushed by the robots [28].

So strip formation is more suitable because it accounts for proper utilization of resources [1][10]. As it is better than

its predecessor it is more formidable and is usually preferred [2].

5. TOPOLOGICAL FORAMTION

A topology has to be made on how the communication between the robots are going to happen between the master robot and the slave robots and also the communication between the slave robots. This type of topology is called Mesh Topology [29]. So each robot can act as its own node. The main advantage is that there is no requirement for a common node. So any node can communicate with any other node in the form of peer to peer communication.

The main outcome of a mesh topology is that data came be transmitted simultaneously allows communication even during traffic [29]. The modification in this topology is done without disrupting the surrounding nodes. Even if there is a failure in component an alternate parent exists [29]. Hence the communication is not affected even if a particular robot is affected.

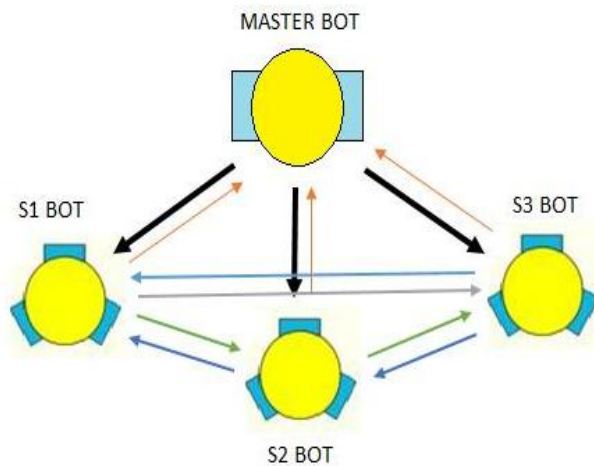


Fig-9: Topological Representation

6. OBJECT RECOGNITION

Open CV refers to the process to doing matrix calculation over an image. It is an image processing library created by Intel. It has diverged number of versions. It is available in various languages which include C, C++ and even the very recently introduced Python.

Object detection which is accomplished by Open CV has the technique called Surf. The premature version of surf is

called shift . They form the basics of image detection. The main drawback of SIFT is that it is very slow while processing the output.

7. IMPLEMENTATION OF THE ROBOT

SURF has an upper hand because it has a very high speed . It approximates the LOG with the box filter.

The implementation part contains four robots wherein the robots are implemented with a Raspberry Pi2 and an Arduino. The master contains a Raspberry Pi2 which forms the brain of the robot. The slave contains Arduinos which form the core of the slave robots.

The means of communication is by ZigBee which forms the means of interaction. The ZigBee module is implemented in each and every robot and this forms the communication process.

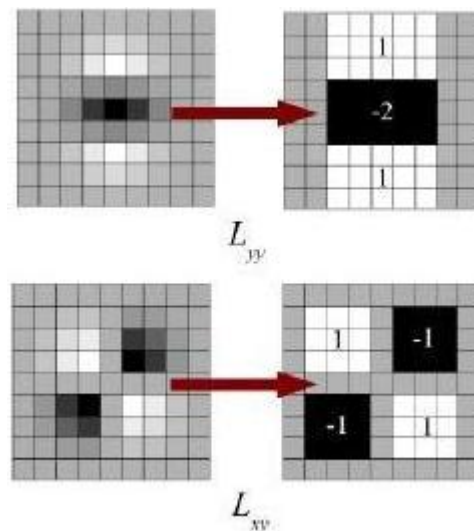


Fig-10: SURF based detection

Another important advancement is the use of Laplacian to find the match and mismatch concept. It distinguishes based on the colour . The sign of Laplacian distinguishes the bright blobs in a dark backgrounds and vice versa.

It has lot of advantages than SIFT in the form that it is three times faster in performance. SURF is good handling images with blurring and rotation.

The motor is fixed to the wheels and this enables the locomotion of the swarm. We know that the swarm concept generally works by the master a slave and this enables the type of locomotion.

8. ADVANTAGES OF THE PROPOSED WORK

The main advantage of the proposed work is that there the speed of data [6] and instruction transfer gets increased and the accounts for the data transfer at a faster rate [26].

The next thing is pattern formation i.e., in the previous models only patterns were formed but this model helps us to us the pattern formed and makes the sharing and pushing of loads possible.



Fig-11: Raspberry Pi2

9. CONCLUSION

Thus we conclude by saying that our robotic model removes the extravagance in the usage of resources and hence saves the money to a greater extent. It ultimately enhances the life time of the robots. Such a thing is achieved because the robot is not prawn to less wear and tear.

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