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Intelligent Navigation and Discovery of Path In Critical Place Using Autonomous Robots

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Abstract

The satellites are being used to find the path in some critical places like bomb blasted building and a new place where the routes are unknown. This method of discovering paths are very costly and it is very complex as that may be require direct connection with location satellites and other communication satellites continuously till the end. This is having some difficulty in getting access for such an service and also it is too critical for implement. This is overcome by implementing an autonomous robot which can deduct and intimate possible ways in that place by using inertial sensors available in Smartphone makes the robot to work with limited conversation between satellites and by placing some number of such an robot in that region all those robots can communicate with each other and increases the efficiency in deducting the path with more details about the length of three dimensional space in all routs. With the datacollected from those autonomous robots it is possible and easy for discovering the path in any place. This reduces the cost of using the satellite and increases the availability of such service.

Introduction

The natural disaster like earth quake and other disaster like bomb blast may cause sudden change on the surface which changes the travelling path. At that time the difficulty in terms of time and man power can be saved by using the robots. These robots usually programmed in such an way it can detect the hypothetical situation and keep saving humans and one single robot shares tasks to other robots in range. All these operations depend on the instruction form server and satellite. These robots use the positioning satellites continuously for achieving the navigation. This uses the direct satellite communication to update the status and current situation to the authenticated security of the region.

Problem Statements

The Positioning System like GPS satellites provides the precise location data calculated from satellite signals through this the navigation information is derived. But GPS fails especially in buildings, mountain areas and underground areas. Considering such an robots they might be limited to the battery, also the satellite communication may use large amount of battery power. The robot can navigate in a terrain with a given set of waypoints spaced with specific distance apart.

There are several methods available for identifying the waypoints they are by using the GPS system, wireless sensor network systems and also with wireless personal area networks. The GPS system produces signal to communicate with the satellite. The connection with minimum of 4 satellites helps to locate the position. The accuracy level of the GPS system depends on the number of satellites connected.

In the wireless sensor network, first the number of sensor signals available is deducted and based on their signal strength and the number of signals available the accuracy of the position depended. while considering the wheel rotation in calculating the number of rotation made, the wheel rotation may also done irrespective of the wheel movement in an mounted of irregular surface and also in surface having mud like substance.

In INDP, the maneuvering an robot can be moved with limited use of positioning satellites by making use of the inertial sensors present in mobile along with the collected sensor data the trajectory of navigation is calculated and the robot is navigated. The trajectory details of the current location will be dynamically loaded to the land rover from the smart phone and this makes that robot in maneuvering to find the destination without any remote controlled device.

Algorithm

The robot design consists of the servo motor of torque capability as required, two geared DC motors for maneuvering is an specific direction. This robot is designed to carry an smart phone, this is controlled autonomously only through the signals from the smartphone. The smartphone will generate signals to control the robot, this signal will be carried out to the rover via the USB port of the smart phone. The inertial sensors- accelerometer, compass and gyroscope form the smartphone is going to be used for determining the locomotion. The pre-loaded trajectory map of the location and the current locomotion based trajectory map generated by the smartphone by using the inertial sensors will be compared and this determine their position with less involvement of the positioning satellite and any other external networks.

```
algorithm sinsar_navigation()
{
sinsar_initialise ();
read (destination);
```

```
disable (accepting_commands);
do
begin map_data = sinsar_loadadditionaldata(location destination);
if ( intelligent_data.avilable() == true)
begin
nextpivotpoint = map_data[intelligent_data];
angleofmovement =nextpivotpoint.degree();
difference = getcompassyaxisangle() – angleofmovement;
if ( difference< 0 )
begin
servo.set(45);
else if ( difference < 0 ) servo.set(135);
end if
until (getcompassyaxisangle() == angleofmovement)
begin
accelerate( dc motor);
end
distance = getdistance(map_data
[current_location], nextpivotpoint );
until (displacement == distance)
begin
accelerate( dc motor);
end
else
angleofmovement = bearing ( map_data[current_location], map_data[destination]);
until (getcompassyaxisangle() == angleofmovement)begin
accelerate( dc motor);
end
end if
end while [ map_data [current_location] == map_data [destination]]
enable(accepting_commands)
end algorithm
algorithm sinsar_navigation()
{
sinsar_initialise ();
read (destination);
disable (accepting_commands);
do
begin
map_data = sinsar_loadadditionaldata(location destination);
if ( intelligent_data.avilable() == true)
begin
nextpivotpoint = map_data[intelligent_data];
angleofmovement =nextpivotpoint.degree();
difference = getcompassyaxisangle() – angleofmovement;
```

```
if ( difference< 0 )
begin
servo.set(45);
else if ( difference < 0 )
servo.set(135);
end if
until (getcompassyaxisangle() == angleofmovement)
begin
accelerate( dc motor);
end
distance = getdistance(map_data[current_location], nextpivotpoint );
until (displacement == distance)
begin
accelerate( dc motor);
end
else
angleofmovement = bearing ( map_data[current_location], map_data[destination]);
until (getcompassyaxisangle() == angleofmovement)begin
accelerate( dc motor);
end
end if
end while [ map_data [current_location] == map_data [destination]]
enable(accepting_commands)
end algorithm
```

The filtered Accelerometer value is noted continuously during each change. The compass reading is listened to maintain the direction. The acceleration produces values in meter per Second Square. When integrating with respect to the time by using numerical integration method and comparing with the gyro sensor values to avoid un wanted noise such as magnetic distraction on compass and Then the speed and direction at different unit of time is calculated with the change in acceleration made on it. The calculated value in converted into a trajectory and by comparing with the pre-loaded trajectory which is an intelligent data about map of the navigation plane the current position and navigation route for the rover is decided. The advantages in using this algorithm are less GPS dependent, battery consumption is less when considering the fully satellite dependent robots and wireless sensor networks, Maneuvering the rover become much easier, Positioning itself is made easy by using the inertial sensors and pre-loaded map.

Archetecture

The robot design consists of the servo motor of torque capability up to 8 kg, stepper motors for maneuvering in specific direction. This rover is designed to carry an smart phone, this rover is controlled autonomously only through the signals from the smartphone. The smartphone will generate the serial command to control the rover, this signal will be carried out to the rover via the Mini USB port of the smart phone. The Figure 1 shows the Architecture diagram

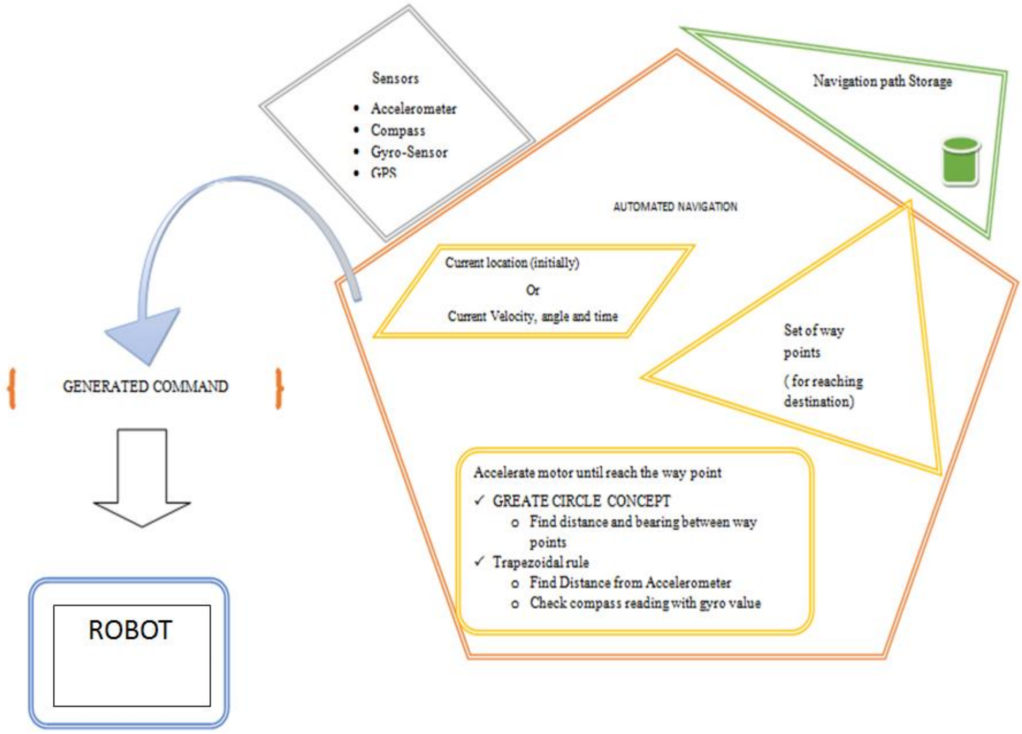

Figure 1: Architecture of INDP

Automated navigation control: The inertial sensors- accelerometer, compass and gyroscope form the smartphone is going to be used for determining the locomotion. The pre-loaded trajectory map of the location and the current locomotion based trajectory map generated by the smartphone by using the inertial sensors will be compared and this determine their position without involvement of the GPS satellite and any other external networks. The filtered Accelerometer value is noted continuously during each change. The compass reading is listened to maintain the direction. The acceleration produces values in meter per Second Square. When integrating with respect to the time by using numerical integration method and comparing with the gyro sensor values to avoid un wanted noise and Then the speed and direction at different unit of time is calculated. The calculated value in converted into a trajectory and by comparing with the pre-loaded trajectory which is an intelligent data about map of the navigation plane the current position and navigation route for the rover is decided. The advantages are less GPS dependent, battery consumption is less when considering the GPS and wireless sensor networks, Maneuvering the rover become much easier, Positioning itself is made easy by using the inertial sensors and pre-loaded map.

Rover control interface: In SINSAR, maneuvering a rover to be navigated with limited use of GPS device by making use of the inertial sensors present in mobile along with the collected sensor data the trajectory of navigation is calculated and the rover is navigated. The trajectory details of the current location will be dynamically loaded to the land rover from the smart phone and this makes that autonomous rover in maneuvering to reach the destination without any remote controlled device.

Map loading: The initial location of the rover can either be instructed by human or it can collect form positioning devise available. After getting the location details, the rover will start moving to the destination after the current location map is loaded at the dynamic time when needed. The current location map is the knowledge for the rover that it can understand the new path for the destination. now it is capable of taking own decision in selecting the path to reach the destiny.

The rover first notes down the angle of movement and the distance to which the rover have to be move. Now the rover will start moving in the direction specified. In parallel the acceleration along the axis of movement will be noted at each moment. The accelerometer value is used in finding the distance of the movement. As the accelerometer sensor is providing value in the unit of meters per Second Square.

Now the different method is applied and tested manually. This testing involves how many instances are needed to provide accuracy in results along with that which method need less number of instances per unit to provide the accurate results in defining the movement and its angle at each unit of time.

This collected data will be calculated at each moment and get compared with the loaded map. This comparison results in determining the position of the rover, Decision making in finding the dynamic routs to the destination.

The positioning is calculated by calculating the reference angle between some subtle points and the distance between them. This makes the positioning done at the rover without the help of the external positioning device. The dynamic decision making can be done by finding the shortest route or best route frOm the current position to the destination.

Motivating Scenario

Placing some number of such an robot in that region all those robots can communicate with each other and increases the efficiency in deducting the path.

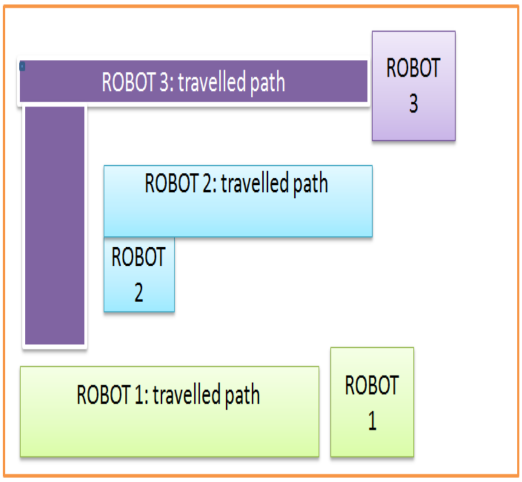

Figure 2: Motivating Scenario

This figure 2 clearly represents that each robot learns the path travelled by each other robot with the limited usage of the communication satellites. This sharing achieved by using local transmitting to robots available in certain range

Expremental Results

This INDP is designed in such a way to increase the performance of robot in maneuvering an area to which the disaster taken place or the region where there is no experienced by human to perform specific task like learning the path finding the objects such as peoples or an evidence and many other purpose with limited use of positioning satellite to extend the battery life of the robot and précising the location with the limited usage of the satellite and maneuver the region.

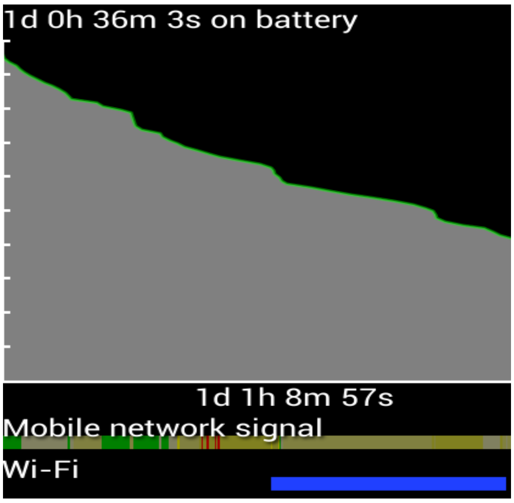

Figure 3: Battery Usage For Less Satellite Dependent

When implementing the multiple robots in such the region each shares their updates with each other and avoids the rework and collision on path detection. The figure 3 represents the increase in battery usage of the device in performing less satellite dependent when compared to the fully satellite dependent robot as proposed by Vishnu Vigneshwar in his journal mentioned in Reference 14.

Conclusion

Implementing an autonomous robot which can deduct and intimate possible ways in that place where the natural disaster like earth quake and other disaster like bomb blast may cause sudden change on the surface which changes the travelling path by using inertial sensors available in Smartphone makes the robot to work with limited conversation between satellites and by placing some number of such an robot in that region all those robots can communicate with each other and increases the efficiency in deducting the path with more details about the length of three dimensional space in all routs. With the data collected from those autonomous robots it is possible and easy for discovering the path in any place. This reduces the cost of using the satellite and increases the availability of such service.

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