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Automatic Delivering System in Hospital Using GPS Tehnology and Efficint Fault Management

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Abstract:
In United States the Automatic Delivery Robots are being used to deliver the medicines, juice, water bottles, medicinal measuring devices, breads. But they are facing some of the difficulties regarding the localization of specific places around and within the Hospital because they are currently using some updated techniques such as landmark recognition and RFID tags. These methods are unreliable and inaccurate, also they require a careful watching and initialization of Hardware in the hospital. Also, some more computations are needed for searching the landmarks hence increasing the cost of the whole Project. In this project we introduce a Multilateration Technique using Smart Global Positioning System(S-GPS). The S-GPS network makes out of Fault tolerances in case of Sensor failures. A Novel based algorithm is being used to find the localization of places and therefore improved Navigation and Delivery of needed items and patients records.

Key words: multilateration technique, Smart Position Global System, novel based algorithm, landmark recognition, RFID tags

1. Introduction

Advances in the field of Robotics have paved the way for introduction of Delivery of Robots to the hospitals. These Robots will be used all around the hospitals for the purpose of delivery of needed items to whoever approaches the Robot for help to   get various items like medicines, food and equipments. The problem mainly faced here is localization of places within the hospitals. There is a chance of mishandling of the Robots if we give power for all to access the robot to all the persons. In order to avoid these confusions, our Project is designed to access only by the doctor and not by the outsiders. Each floor of the hospitals can be provided with the single robot.

This is a concept of point to point delivery. This delivery robot can also be used as a surveillance robot by placing a camera with the robot and the receiving station at the control room. In our system we provided with a recording system which is handled by the doctor and the delivery system which is handled by the shopkeeper. Deliver y of medicines is done by providing RFID tags to each patient to avoid the misuse and confusion during delivery. Periodically, the robot is called by the doctor to give away the medicines and prescription to the patients which avoids the man power and   therefore the country's economy is being developed since hospitals pay the way for higher employment and expenditure. Our goal is to establish the movement of the robot in offline and real time scheduling.

2. Challenges Being Faced by the Hospital Environment

- Safety: There are two in this section. The robot should deliver the medicines correctly to the patients and should safely pass awa y the patients.
- Obstacle detection: The robot should identify the objects in and around it.
- Map of the environment: Finding the efficient technique to find the root for the map.
- Follow the path: We should be able to tell that the robot have reached the destination point and had delivered the goods correctly.
- Navigation: The robot itself should know the position of the robot with respect to the destination point and it should have the ability to calculate the remaining distance. Want to avoid artificial landmarks like stickers and temporary recognition Robots must be able to operate in narrow environment also.
- Organising the robot action: To organize the communication between robot to the supervisory system. And also ordering the tasks. Each unit should be monitored continuously and should work even though work if any of the system fails. Automatic use of elevators and doors We should allot place for parking of the robots and charging of robots

The robot should be ale to identify its fault in any of the system and should be able to inform to the surveying environment Suitable boxes like arrangement should be provided to carry and deliver the goods.

The robot should be ease of use to the users. Stable transportation : The robot should be able to carry the goods stability and should not accessible to the random people.

3. Need for the Project

Because of the Automatic Delivery of medicines the pharmacy technicians can focus on careful mixing of IVs. Delivery of medicines can be frequent and periodical and the nurses need not to be worry about the missing medicines. Automatic delivery system brings out down the cost of delivery and time is also so much consumed. The nurses number and their salaries can be   ver y much reduced. The nurses can keenly and fully focus on the patients rather than moving to bring the needed items.Wastes can be collected frequently and keep the hospital surrounding clean as possible. Delivery through robots will cause the process in hospital to be speed up and efficient. Because of the items are being handled by the Robots there will be no missing of items incase of costly items.

4. Existing System

Outdated techniques such as RFID tags and Landmark Recognition was being used by various hospitals in New York. [10] Landmark recognition is being used to find the current position of the Robot by using the localization techniques in which the current position is being calculated by comparing it with the geographic position of the maps. In this technique the drawbacks are if the current position is changed with respect to the original position then the Landmark recognition can't find out. The new position even though there is a reference point. Hence this system is found to be the in efficient since the system will only work when all places are stationary. A slight modification in distance will collapse the whole system. Observation of landmark varies from one place to another. In addition to these disturbances an illumination charge, external cutter, var ying geometry, affects the reference landmarks. It is difficult to observe the 3D applications also. Because of this strong recognition techniques can't be done properly. [7] RFID- (Radio Frequency Identification tag) is being used where the circuit is integrated with the antenna which transmits a serial number to the reading device.

This system has its own disadvantage in the sense that if the tag is being missed the RFID tag can't read the respective places location and therefore failure of the robot. Here also more components are needed so cost of the project automatically increases.

Deploying RFID technology can interfere with the medical devices. It is not always reliable. The RFID read accuracy depends upon tagged object, its placement, angle of rotation, read distance, etc. Because of these disadvantages the large scale industries have not allowed this RFID technology in their industries. [13] Localization can also be achieved using the RFID tag by providing the Robot with the reader, giving away the RFID tags   to each place since the Robot having the table of distribution of each tag. There is a chance of misuse of the signals being transmitted by the transmitter.Since RFID tag involves the personal information of the patients the health care unit should be aware of leakage of the patient's information.

The other disadvantages are

- Lack of organizational support
- Trust issues Security concerns Orientation of the sensors
- Type of algorithm needs higher knowledge and practice.

Here the disadvantage is that the location change can change the destination points hence wrong identification of places by the robot. To encounter these difficulties the GPS technology is being involved. [15] using the line follow ing robot: In this method the destination places are already predefined in the program to follow the line or track for the movement of the robot.

This method is accomplishing by having two Infrared sensors to differentiate between the two colors and proceeds its path.

If there is any obstacles in its path it cannot find the another path for movement and so the task will be incomplete and it cannot resume its operation. A separate path should be provided for the robot since there is a chance of mispath of the robot. A comparator is being provided to compare the signals received from both the colors and so the robot moves in its path. A highly accurate sensors should be provided for perfect transportation which increases the overall cost of the whole system. To overcome this problem a new technology in the absence of line tracking is being followed.

5. Overall Drawbacks of Existing System

- Cost of the system is very much high
- Location of position of places is very much difficult. If in case of fault occurance the robot will stop its job of delivering goods and remains idle.
- If in case of any obstacles the robot is inefficient to resume its original position.
- The robot is inaccurate in finding of a correct location of the specific places.

6. Proposed System

We propose a Novel based algorithm with Multilateration technique using Smart Global Positioning systems (S- GPS) network for localization of places inside the hospitals.

The S-GPS framework will consist of all the coordinates of the location of the places within the hospital and provides ease of fault tolerance and finding the sensor failures.

Some hardware is being needed to save the position of the places using RFID architecture equipped with ToF-engine which provides the distance between the two wireless modules. In order to perform the first mapping, three or more modules must be set as static nodes and must be matched with their locations so that they can act as a references.

The S-GPS network will be acted as a master- slave architecture where the individual modules can act as a slaves and the central system will act as a master. The server is responsible for the multilaterional performance.

Here frequent readings are being taken to avoid the mismatch of signals. The experiment should be repeated until correct recognition of places. The present system is used as a real time object where all the process are done automatically either timely basis or by the command given by the doctor.

The proposed system also includes the option of fault management and obstacle detection.

Since battery plays a major role in movement of the robot a battery replacement technology can also be included here.

This proposed system is not only used in hospitals but also in various industries and educational system where automatic delivery of goods is necessary.

7. Advantages of Proposed System

- It is cost efficient.
- Robots will fall never sick. So it does not need any holidays and also will work in all days.Robots will not make any mistakes as done by the humans
- Since all work can be done automatically there is no need of tiredness and so efficient work is surely be possible
- Hospital personnel or nurses can focus highly on patients
- All work can be scheduled and there can be done in night shift also.
- There is no need of high salary to the patients. Time for delivering the medicines is very much reduced and is highly confidential.
- There is no chance of lost of medicines and ensuring correct time delivery of medicines to the patients and the patient condition can also be repeated to the doctor periodically.

8. Brief Description of the Technology Involved

Multilateration Technique is a positioning technique with which we can measure the distance of target unknown location from the one or more known references. As previously stated the distance measurement can be achieved by using a ToF engine, calculating the time spent by a signal to travel from the reference to the target and back to the reference.

It is obtained from the distance measurements can be used for simulation result. The accuracy of this system can be increased by having one or more reference points. If three references is used it is considered as a over determined system and a linear equation is being formed. Three unknowns will leave as a easily solvable distance equation. The references should be in predefined number.

9. Hardware Description

Here in this section the PIC microcontroller act as a heart of the circuit. The prescription of the doctor is being recorded the patient for each patients in the hospital and the robot is sent to the medical store. The shop keeper will now hear all the prescriptions by the doctor and put medicines in the tray of the robot and will lock the boxes using RFID tags. The robot is now sent to the respective patients to deliver the medicines and other needed items prescribed by the doctors. The robot when enters the patients room will give up a beep sound to indicate the patients that a robot has arrived to their places to deliver the needed items. The patients are persons who came with the patients can take out their medicines with respective RFID tags.

This will avoid the mishandling and confusion of medicines. A Real time clock also provided for the patients to take up their medicines. After finishing all the jobs the Robot will come to its original position itself. Likewise the robot can be called up by the doctor to deliver the timely medicines and the actual position of the patients can all be entered and showed up to the doctor. The hardware involves a battery for the movement of the drive. The doctor to the store keeper path should be able to be identified by the robot by using the GPS technology. The robot should be able to recognize any obstacle in its path and it should give an alarm to get away the obstacle.

When we are using the elevator system for the robots a separate ir sensor should be provided to communicate with the elevator.

The GPS will take the reference points within the building within the gap of at least 10 meters. The GPS should be accurate enough to provide the details of the patients room, doctor's room and the medicalstore. The PIC 16f877a is being used to process the decoded information and should go in accordance with the direction of the destination. The RFID technology is used as a secure and cheapest way of transmitting the medicines to the respective rooms. The RFID tag when shown with the boxes the code receives the particular signal and the box opens. The two motors should be operated in parallel in front to avoid skidding of the motor. The GPS technology works with the basis of Multi-lateration technique in the basis of Novel based algorithm in which the position can be identified without any mismatch.
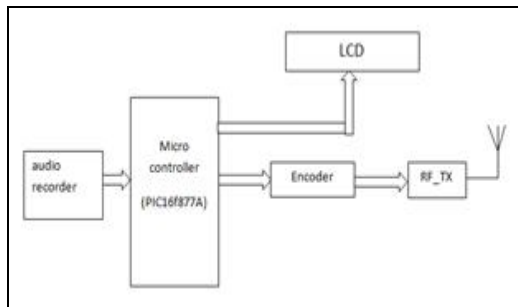
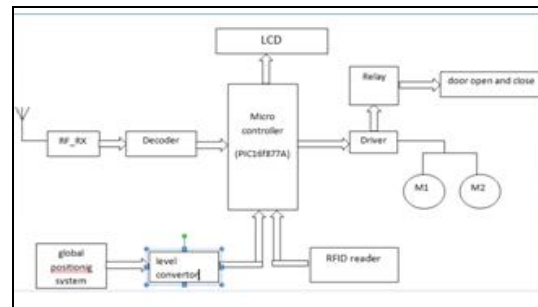Figure 1: Robot in Recording Section   Figure 2: Robot in Delivering Section

An indication system should be provided with the robot to indicate the doctor that delivery of goods have finished successfully. Task can also be scheduled to the robot during offline and to a specific time using Real time clock. The tasks can also be repeated with desired frequency. Level convertor will guide the GPS in case of slight change in position of the robot or presence of an obstacles.

10. Simulation Result
The whole project can be implemented and monitored using MATLAB to show the getting of command and carrying out the actions performed by the robot to deliver the goods.
We can also indicate the fault indication and the completion of work through a light indication. We can also completely monitor the movement of the robot and its work in the computer for the doctors reference. A graph can be drawn between the time the command is given to the speed of the robot. When drawing a graph we can get a linear performance

11. Conclusion and Challenges
This paper describes the main challenges that could be met, when designing a robot-based logistics system for hospitals. The existing systems, solutions and state of the art in the autonomous transportation within the hospitals has been also described.

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