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CAMPRO-G: An Autonomous Mobile Robot Guide for Campus using IoT

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ABSTRACT

An autonomous mobile robot has been designed and released to guide the visitors throughout the university campus. This robot accompanies guests throughout the campus and gives presentations on predefined locations. The robot recognizes the human voice and pitch clarity with the help of AMR application. After the robot, reaches the destination with the help of pre-defined tags. The path distance is calculated by using have sine formula. The map is generated as a 2D graph having (x, y) coordinates. Data of location is obtained from its memory and targets such as faculty building, museum etc. That is recognized by the pre-defined tags of image processing. A single server has to deal with all the incoming requests and to effectively manage them, queues are maintained.HCM 5883LMagnetometer are using to identify the directions such as north, east, west and south. The HC-05 is a Bluetooth module. The commands are passed to the Bluetooth. Zig-Bee is used for effective communication and track the robot among the web interface. The 16X2 LCD monitor is using to show what commands that robot accepted in particular time. If the robot in current locations and log files, it will also be maintained in that web interface.

Keywords: *Compass; Magnetometer; Navigation; compatibility; adoptable;*

I. INTRODUCTION

For any mobile device, the flexibility to navigate in its setting is vital. Avoiding dangerous things comparable to collisions and unsaved conditions compared to Temperature, radiation, exposure to weather, etc. comes 1st, however, if the mechanism features a purpose that relates to specific places within the mechanism setting, it should notice those places. Mechanism Navigation helps to spot the essential blocks of a mechanism navigation system, sorts of navigation systems, and also the nearer consider its connected building elements. Mechanism navigation suggests that the robot's ability to see its own position in its frame of reference and so to arrange a path towards some goal location. To navigate in its setting, the mechanism or the other quality device needs illustration, i.e. a map of the setting and also the ability to interpret that illustration.

A. Self-Localization

The Map during this context denotes any matched mapping of the globe onto an enclosed illustration. Automaton Localization denotes the robot's ability to determine its own position and orientation at intervals the frame of reference.

B. Path Planning

Path planning is effectively an extension of localization, in that it requires the determination of the robot's current position and a position of a goal location, both within the same frame of reference or coordinates.

C. Map-building

Map building can be in the shape of a metric map or any notation describing locations in the robot frame of reference.

D. Navigation

Fig.1. Magnetic Compass

E. Vision-based Navigation

Vision-based navigation or optical navigation uses computer vision algorithms and optical sensors, including laser-based range finder and photometric cameras using CCD arrays, to extract the visual features required to the localization in the surrounding environment. However, there is a range of techniques for navigation and localization using vision information, the main components of each technique such as Representations of the environment, Sensing models, and Localization algorithms. To give an overview of vision-based navigation and its techniques can be classified indoor navigation and outdoor navigation.

F. Indoor Navigation

The goal of the robot is easiest method to creating location is solely and guides it there to location. This steerage will be drained alternative ways, burial associate inductive loop or magnets within the floor, painting lines on the ground, or by inserting beacons, markers, barcodes etc. within the atmosphere.

Such machine-controlled guided Vehicles (AGVs) are a unit utilized in industrial eventualities for transportation tasks. There are unit a really wider type of indoor navigation systems

G. Outdoor Navigation

Outdoor navigation consists of the navigation in outside environments similar to nature trails. It's used chiefly by outside enthusiasts and outside staff. Outside navigation maps a lot of closely connected with geographic harts and military charts instead of being street and road orientated.

Outside navigation is generally done victimization custom handheld outside receivers though the standalone application running on a mobile device can even be used. These applications ordinarily add a very offline mode, since cellular coverage is typically unavailable within the places wherever outside navigation applications area unit to be used.

H. Localization

Localization techniques that work fine for one robot in one environment may not work well or are in any respect in another environment. As an instance, localizations that work well in associated outdoors atmosphere could also be useless inside.

Current Location

Dead Reckoning

Dead reckoning uses meter to live, however so much the robot moves. Trig and also the equations of mechanics area unit all that's required to calculate its new position. Dead reckoning is commonly used with different strategies to enhance the general accuracy.

Least Mean Squares

issue is choosing an associate algorithmic program to search out the robotic location is that the handiness of correct relative and world position information.For straightforward There are a unit varied solutions to the localization artificial intelligence downside. These vary from straightforward Dead Reckoning strategies to advanced algorithms with dear radio detection and ranging or vision system. The foremost vital systems with basic relative position sensing elements and a few varieties of a worldwide position sensor, the foremost sensible and best to implement the localization technique is that of Least Mean Squares.

II. LITERATURE SURVEY

[1]Numbers of Caregivers and care facilities are already in a shortage in many areas. Instead, communication type of care robot could contribute more to facility care and day service. New collaboration services between human and the communication type of care robots with Artificial Intelligence (AI) and Big-Data that exceed human capabilities could be an effective solution for caregiver and care facility shortage problems. It analyzes how communication between Human and Care Robots (HCR) successfully performed for both recreations and health gymnastics in two types of cares, (I) facility care and (II) day service, using the robot function of humanoid speaking and actions. It also discusses the effective roles of facilitators and strategies of facilitations for managing new collaboration that produces synergy effects among

caregivers, care-receivers, and the communication type of robots, as "care robot innovation."

[2]Speech Recognition is a technology which allows the processing of a speech input to text and is speaker independent. This allows it to be used in numerous applications ranging from digital assistants to controlling machinery. It proposes a strategy which can be used in controlling a robotic vehicle through connected speech input. The speech recognizer platform will be an Android smartphone which communicates with the robot using Bluetooth connectivity. This method allows for efficient recognition and smooth data transfer. Additionally, the robot will also have the capability to detect obstacles and inform the user to use a different command. It will be useful for applications such as assistive robots for people with disabilities or in industrial applications such as work robots.

[3]There is a need for technological reform and innovation in public transport because of the increasing number of passengers. In order to ease up the problems arising from the increasing number of passengers, the number of services can be increased and the transit times between stops can be shortened, which result in drivers' weariness and speeding leading to accidents. For that reason, the integration of technology to public transport becomes a must to prevent such accidents.

[4]The robot controlling through Wi-Fi is an interesting tool to perform laboratory experiments within Electronics and Telecommunication Engineering. Designing of the system requires the knowledge of physical components, sensors, embedded system and decision algorithm. As it knows humans cannot perform any task which a Robot can do. Robots are required where human interventions are nearly impossible. Due to this, a concept of designing a robot which can be controlled through Wi-Fi emerged in our minds. Here controls of the robot are integrated on a webpage. It comprises modules Wi-Fi Module, Router and Microcontroller which handles all basic functionalities of a Robot.

[5]Robot mapping or trajectory plotting is the process of building an environment representation using mobile robot. A design and implementation of mapping robot was developed using Digital Magnetic Compass and Ultrasonic sensor, Arduino UNO which is having Atmel's AtTmega328 microcontroller. It presents mapping of mobile robot in the indoor environment. The designed robot uses metric, world centric approach for mapping algorithm. Robot follows the wall while continuously sending it's co-ordinates to the base station. Base station or map monitor has PC with Bluetooth link connected with mobile robot and map is plotted on NT's LabView graph. The proposed approach is simple and low cost useful in robotic application to solve SLAM problem.

[6]Line follower robot is a robot car that can follow a path. The path can be visible like a black line on the white surface. It is an integrated design from the knowledge of Mechanical, Electrical and Computer engineering. This paper presents a 700gm weight of a 9W LDR sensor based line follower robot design and fabrication procedure which always directs along the black mark on the white surface. The electromechanical robot dimension is 5.257 cubic inches with a cost of BDT 1150. This low cost fundamental electronic component based line sensing robot can carry a load of about 500gm without getting off the line.

[7]To explore possible robot tasks in daily life, we developed a guide robot for a shopping mall was developed and conducted a field trial with it. The robot was designed to interact naturally with customers and to effectively provide shopping information. It was also designed to repeatedly interact with people to build a rapport; since a shopping mall is a place where people repeatedly visit, it provides the chance to explicitly design a robot for multiple interactions. For this capability, RFID tags were used for personal identification. The robot was semiautonomous, partially controlled by a human operator, to cope with the difficulty of speech recognition in a real environment and to handle unexpected situations.

[8]Personality is an essential feature for creating socially interactive robots. Studies on this dimension will facilitate enhanced Human-Robot Interaction (HRI). Using Artificial Intelligence Bot (AIBO), a social robotic pet developed by Sony, the issue of personality in HRI was examined. In this gender-balanced 2 by 2 (participant personality: introvert vs. extrovert) between-subject experiment (N = 48), it was found that participants could accurately recognize a robot's personality based on its verbal and nonverbal behaviors. In addition, various complementarity attraction effects were found in HRI. Participants enjoyed interacting with a robot mode when the robot's personality was complementary to

their own personalities than when the robot's personality was similar to their own personalities. The same complementarity attraction effect was found in participants' evaluation of the robot's intelligence and social attraction. Participants' feelings of social presence during the interaction were a significant mediator for the complementarity attraction effects observed.

II. EXISTING SYSTEM

The existing system used for designing a Robot that can be operated using Android mobile phone. The controlling of the Robot is done wirelessly through Android smartphone using the Bluetooth feature present in it. Here in the system, the Android smart phone is used as a remote control for operating the Robot. The controlling device of the whole system is a Microcontroller. Bluetooth module and DC motors are interfaced to the Microcontroller. The data received by the Bluetooth module from Android smartphone is fed as input to the controller. The controller acts accordingly on the DC motors of the Robot. In this system, the controller is loaded with a program written using Embedded 'C' language. The system shows how the android Smartphone can be used as a remote controller for the robot and various embedded technologies with the help of the Bluetooth technology. This robot can be used for traveling purpose. The disadvantages of existing system is that, delay in transmission and reception of commands is high. The Bluetooth connection gets dropped frequently. Location of the system can be tracked using GPS/GSM modules. The programs need to be updated to suit the changing requirements. The robot needs to be made smarter

IV.PROPOSED SYSTEM

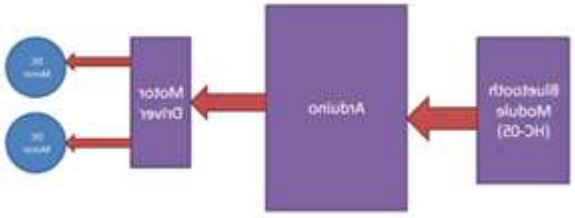

Fig.2.System Architecture

The basic block diagram of the CAMPRO-G is represented in following Fig.2. It consists of the Smartphone that acknowledges the voice commands and is being wirelessly transferred to the Bluetooth module HC05. The module then converts the command text and therefore the strings of the character's area unit sent to the Arduino for any process. The comments showed on the alphanumeric display. The Arduino microcontroller decodes the string obtained and correspondingly performs any functions.The signals are a unit sent to the motor protect that thus powers and drives the motors connected to that. The mechanism uses the pre-generated map learned by desegregation GPS information and motion device data. The map is employed in navigating our mechanism to nominal the required location for multiple request service supported the task specified by the shopper is shown below.Fig.3.

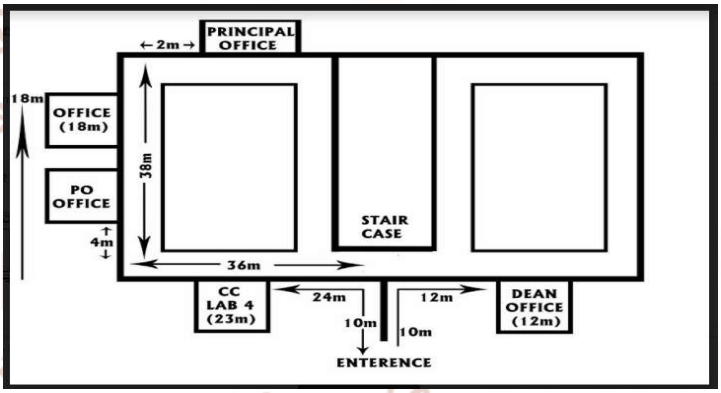

Fig.3. Site Map

V. ALGORITHMS AND TECHNIQUES

a) HAVERSINE FORMULA

The haversine formula is employed to see the space between 2 points on a sphere given their line of longitude and latitudes. Vital in navigation, it's a special case of an additional general formula in trig, the law of haversine that relates the edges and angles of spherical triangles.

For any two points,

$$\text{hav}(d/r) = \text{hav}(x2-x1) + \cos(x1)\cos(x2)\,\text{hav}(y2-y1)$$

- d is the distance between the two points
- x1,x2: latitude of point 1 and latitude of point 2
- y1,y2: longitude of point 1 and longitude of point 2
- hav is the haversine function

The robot once moves to destination 1st it'll realize the line of longitude and latitude purpose from getting down to ending purpose. At first the robot having 2 points such as beginning and also the ending point. The 2 points are mounted in the predefined locations. Once finding the destination, the robot finds the shortest path from supply to destination. To finding the shortest distance, haversine formula is utilized.

And additionally the haversine formula is employed to send the alert message to the positioning map.

VI. IMPLEMENTATION

The mechanism is formed from AN Arduino board, motor driver, two DC motors and Bluetooth module HC-05. First of all the info from the golem application is shipped as AN input to the Bluetooth module that any provides it to the Arduino Nano; The Nano could be a controller that controls the signals and performs the allotted functions and it understands that signals have to be compelled to be forwarded to the motor driver in order that it moves specifically order. Like in, if the users have approached the left button on the applying, the Arduino can send the signal to the motor driver to activate the left pins and consequently move the motors in order that the wheels will follow the direction.User provide directions through the applying to the microcontroller with the assistance of Bluetooth, then Arduino handles DC motors and allows the high signal at specific motor pins. The motor driver has many pins and people pins that get a high signal activates the DC motor, like pins five, six for the left motor and nine, ten for the proper motor. The site maphas been already foreign into the mechanism. So, the mechanism reaches the destination simply. An entire map of the field was created with the assistance of a map for the motion detector. Motion sensors were employed in the indoor areas. This world positioning system wanted to create nodes that represent all the areas, buildings, rooms etc.These nodes were connected by conniving the particular distances between them victimization the line of longitude, latitude of the placement and so conniving the trail distance by victimization Haversine formula. The map is generated as a second graph having (x, y) coordinates. Robot acknowledges sure buildings in an exceedingly field victimization the predefined location tags keep in their memory. These tags provide information concerning the placement and additionally assign the subsequent relay planning. The operator of this service robot takes into thought to union of multiple requests. One server should contend with all the incoming requests and to effectively manage them, queues are maintained. This queue stores all the requests from totally different nodes incoming at different times. A singular shopper ID issued to the requesting node so as to assure the acceptance of its request. That the acknowledgment sent to the shopper includes a singular shopper ID generated at runtime and additionally calculates the time needed by the mechanism to serve the request. The time is generated to support its distance from the destination. To ensure efficient working of the robot, a total of two queues are maintained. This module has the packet format sent by each client, requesting a service. This diagram shows the format of the packet sent by the client to the robot which in turn passes it to obtain the data which is analyzed to perform the required.

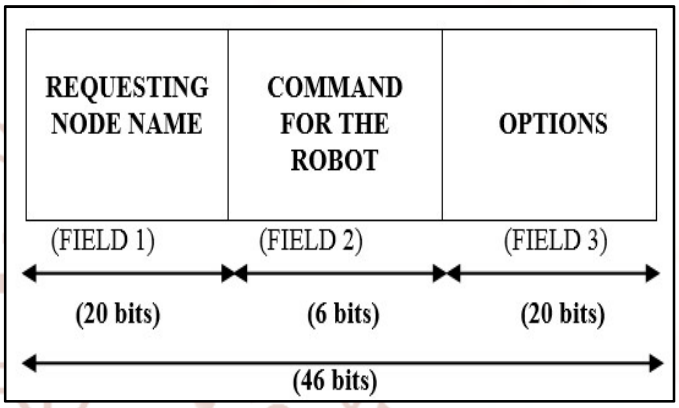

Fig.4. Packet Format and Parsing

FIELDS IN THE REQUEST PACKET

This field specifies the name of the node that requested for a particular service. The requesting node whereas causation this packet set up its name to permit the mechanism to spot the origin of the request. This field of half-dozen bits specifies the work to be performed by the robot at the desired location. The robot, whereas parsing the request identifies the command nominative here because the job to be meted out. This field contains the name of nodes per the work nominative by the user to be done. The situation of the mechanism is instantly saved within the cloud to find the mechanism. Cloud handles data regarding the mechanical field, map and different admin interfaces. The situation will be simply half-track victimization the net interface. Just in case of any drawback thereon mechanical, at that point cloud service is employed. This admin interfaces supported internet. There are 3 varieties of interfaces.

VII. RESULTS AND DISCUSSIONS

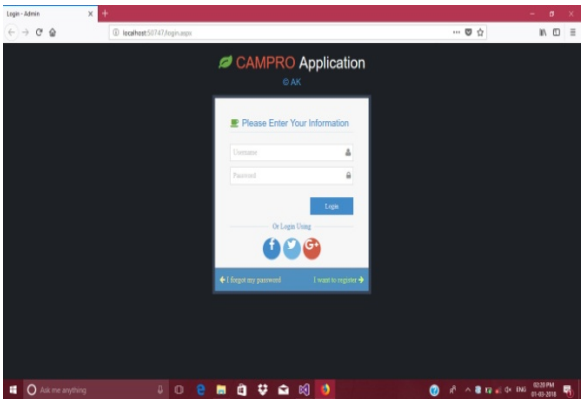

Fig.5.Login Page

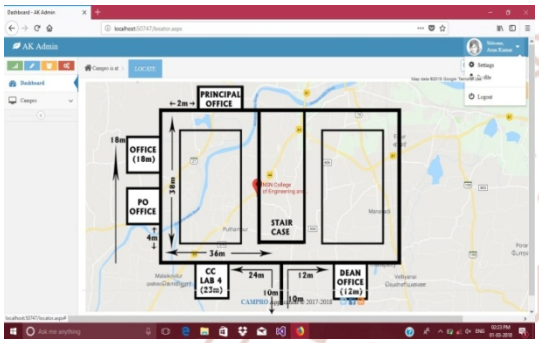

Fig.6. Site Map Page

VIII. CONCLUSION AND FUTURE WORK

The robot can be used for guiding purpose and reach the actual destination, simply with the assistance of the positioning map reference. The positioning map has been already imported into the robot. It's additionally acknowledges all sorts of voices with pitch clarity by Android application. It'll send the notification message once it reaches the destination. The robot controlled and monitored at the web page to facilitate of Wi-Fi module. The robot can be accessed from anyplace. It's terribly useful for guiding who getting into the new place. This robot is like a human beings or toys but it can be able to fly, run. It can be able to move in a flat surface. In a proposed system, magnetometer is used for finding the place in the indoor navigation. In magnetometer, the moving position will be calculated by (X, Y) coordinates is called as node. In future, instead of magnetometer, GPS device can be used to identify the location of the robot. It can be used to identify the latitude and longitude points in the particular location. In the proposed system, single language can be used to identify the location. But in future work, multiple languages can be accepted by the robot can be used to identify the particular location of the place. In proposed system, video recording cannot be able to take in that place. But in future work, vision power (camera) can be added to recording of the particular place.

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