

ARTICLE

AUTOMATED MOBILITY SUPPORT SYSTEM FOR
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ABSTRACT



Now a days, in many home care centers where the nurses or care taker will supply the medicine and proper food to the patients time to time but usually the home care centers are not afforded by all the people. The proposed research is to provide better service for the patients, kids and the aged people. The support system is provided with DC geared motors which is controlled through android app or voice command. The support system is mobilized by the need for supplying medicine, food and other supplies. This makes the aged and the bedridden patients partially independent. The system is designed with open source development board, Bluetooth module for communication between the system and user mobile and a suitable android app for controlling and monitoring the environmental parameters. The heart of the proposed research is controller and the smart Bluetooth which direct the geared DC motors to predefined path through the suitable motor driver. The components which are used in the design were simple and easily available which promotes easier construction and design. This design can also be used in hospitals that makes the people independent to get the needs of patient time to time.

INTRODUCTION

KEY WORDS
Smart Trolley, Patients,
Controller, Smart
Bluetooth Kit,
Atmospheric Condition

The main objective of the project is to serve bedridden people who are completely dependent on their care-taker. Now a days there are many home care centres where nurses or some care taker are sent to the needy by hiring them. Usually these home care centres are not afforded by all the people as it becomes a little costlier. This research provides an opportunity for the person who in need of medication, food and other supplies time to time on the daily basis making them partially independent by reducing the work load of the care taker. As it comes to a daily basis system, the person knows well about the time of the medication and other required supplies for them and accesses the device by using various option provided by automated mobility system. Sometimes it becomes difficult for the care takers who is one of the family member mostly to provide service in their work busy or they tend to forget to provide medicines, in such cases this automated mobility system helps the care taker to serve the needy.

The present hospital service system in India definitely needs an improvisation. The focus of hospital managements on to improve on all the aspects of the patients care and satisfaction [1]. A food/medicine delivery system must be hygienic and quality in hospitals which has definite beneficial effects on the recovery of patients and their quality of life [2]. Nutritional and Aesthetic quality is preserved throughout the service time by using a food trolley [3]. The trolley method of food distribution enables all foods to have a more acceptable texture and temperature than the plate system of delivery in hospitals. Patient's acceptance of served food is more towards the food served using food trolleys than the other [4]. However, with the trolley system patient satisfaction was improved, where 94% of patients were satisfied compared to 77% with the plate system. This indicates that nutritionally, the method of meal and medicine delivery is immaterial but patients do prefer choice at the point of consumption [5].

This automated mobility system is very easy to access and it is provided with an open source application where one can easily make use of the device. The automated mobility system consists of a trolley which is the main equipment used for serving the bedridden people or the needy. It can also be used to serve old people having difficulties. The device is operated through an app which is connected to the equipment through Bluetooth. The trolley is sent from one place to another which is a predefined path. On reaching the destination alerts the care taker for the supply. There is enough time provided at the destination to place the supplements on the trolley and the trolley comes back the original place that is to the patient or to the needy. The time taken to travel and the halt time are predefined. There can be as many different paths to travel say room-1, room-2 and so on. The trolley is also provided with shelf where the frequent requirements are also kept. Being easy to operate by all age people with various option provided it is adapted easily and bought into use. The whole equipment is a single trolley device and an app in your phone or tablet.

Objective

The proposed project is designed to provide better service for the patients, kids and aged people. It consists of a trolley provided with DC geared motors which is controlled through Android App or Voice Command. The trolley is sent and received where it is utilized by providing the needy by medicine, food and other supplies. This makes the aged one or the needy partially independent, still there must be a person to place the supplies on the trolley.

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Received: 22 Jan 2017
Accepted: 3 April 2017
Published: 1 June 2017

SYSTEM ANALYSIS

Existing system

In present situation, the nurses from the care centre provide medicines and food for the aged or bedridden people. It is not sure that the medicines are going to them on time [6]. If in some emergency cases, the nurses will forgot to give the medicines. In some cases like if the bedridden people needs some water or something else immediately they cannot call the nurses at that instance. Some people doesn't prefer these care centre due to insecurity. The conventional trolley [7] which is used for supplying medicines or food in hospitals and care centres are shown in figure 1.



Fig. 1: Traditional Mobility System.

Problem statement

The objective of this project is to help the aged and disabled to carry out their chores. This uplifts their courage to work on their own; while reducing the workload of the caretaker simultaneously. In a manner, it turns out to be more efficient for the people under life term medication, as it can deliver their medicines on time and at regular intervals. We provide the model to serve them better and providing 24x7 monitoring in special wards by also supporting the caretaker with the needs to help the needy [9].

Proposed system

Block diagram

The block diagram is shown figure 2 which gives the detailed explanation about the mobility system. The central processing unit is arduino uno development board which processes and controls the system very effectively and accurately. The distance sensor is used as obstacle detector which alerts the person while the system travels through the predefined path. The bluetooth is connected to the development for the effective communication between the board and the user mobile. The optional feature also included in the system that user can operate the device without using smart phone through voice command. For recognizing voice command, voice recorder and voice recognizer is also attached with the controller. The motors cannot be driven directly by the controller since the controller will deliver the low level digital signals. So that the system is provided with the suitable motor driver depends on the rating of the DC motor. The integrated sensor unit called WICED sensor is connected with the processing unit for condition monitoring [8] of the patient room remotely.

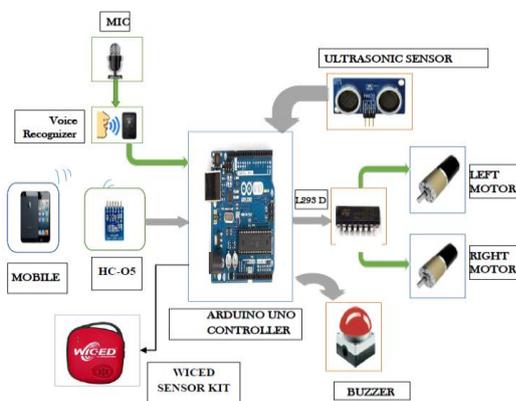


Fig. 2: Block Diagram of Proposed System.

SYSTEM IMPLEMENTATION

Hardware

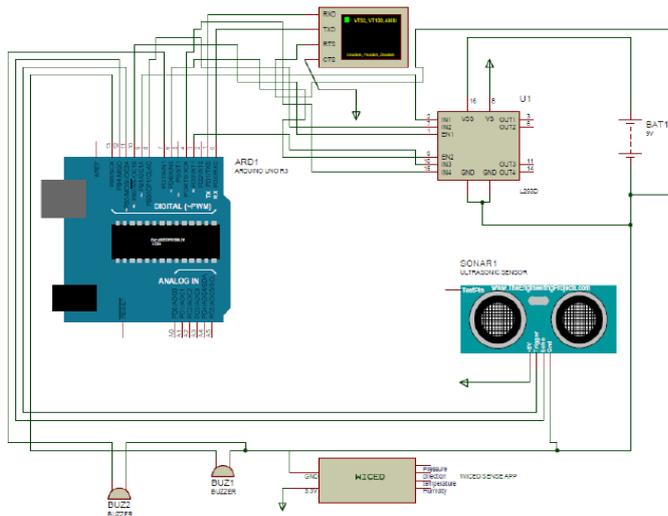


Fig. 3: Schematic and Wiring Diagram of the Proposed System.

The schematic and wiring diagram is shown in figure 3. Arduino Uno development board is selected as controller because of open source platform and for easy programming. The power switch on the trolley is pressed once, the device is ready to pair with smart phone or a tablet through bluetooth. The WICED sensor will be activated and start to monitor the environmental condition and the data's are transferred wirelessly.

The device is controlled through android app which is installed in user mobile phone or tablet and condition monitoring is done in nursing station. The device also controlled with the voice recognizer. The voice recorder will record and store the voice of the patient and recognizer will sends the analog signal to the controller according to the voice command. Once the Arduino receives the command through the serial port, it start to processes and the respective digital signals is sent to L239D and the DC motors are driven accordingly. L298D motor driver has the ability of controlling the motor in both forward motoring and reverse motoring.

In addition to that a couple of buzzers are connected to the digital pins of the controller for alerting the person to keep the needs on the trolley and alerting if any obstacles in the travelling path of the trolley. To provide an additional information like pressure, temperature, humidity of the patient room, WICED smart sensor is connected which will process the parameters and sends the data wirelessly to the nursing station.

The travelling path of the trolley is fixed according to the distance of the patient's room. For instance, the patient or the person in need of supplies as pressed up arrow in the app, the corresponding serial data is received by the module HC-05 and transmits the same command to the arduino indicating that the trolley should be sent to the room 1. The Arduino processes the command for L298D to drive the motor. Now the time taken for the motors to drive 10 seconds in forward path and 2 seconds to turn left or right and again travels say 5 seconds to the destination. Once the destination is reached, the buzzer alerts the person or nurse to provide the necessary. In case of any obstacles in the travelling path the buzzer alerts with the help of the ultrasonic sensor connected to the controller. The range of the detection of the obstacles can be programmed in the arduino platform. The time for the stay of trolley in the destination is also pre-programmed and returns to the person who is the bedridden person or the person who operates.

Software

Arduino open source platform

The Arduino Software (IDE) is open source platform [10] and it is easy to program and fetch it to the board. Arduino IDE runs on Windows, Mac OS X, and Linux. This software is written in Java language and based on processing and other open source software. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The coding for the controlling and processing is fetched into the ATMEGA328P microcontroller with the help of breakout board called Arduino Uno. The controlling of motor and parameter monitoring statement is started in void loop() for infinite operation. The pin mode declaration and serial port communication is

declared in void setup() for one time running on the controller. The variable declaration and pin mode configuration of the proposed research is shown in figure 4.

```
Motor_Control_Editor_1_wm_4rta
Motor_Control_Editor_1_wm_4rta
#define BUZZER 13
int motorPin1 = 2; // pin 2 on L293D IC
int motorPin2 = 4; // pin 3 on L293D IC
int enablePin1 = 6; // pin 1 on L293D IC
int motorPin3 = 5; // pin 15 on L293D IC
int motorPin4 = 8; // pin 15 on L293D IC
int enablePin = 11; // pin 9 on L293D IC
int state;
int flag=0; //makes sure that the serial only prints once the state
void stateChange() {
  void writePin(int pin) = 0;
  void setup() {
    // set a line pin as output:
    Serial.begin (9600);
    pinMode(motorPin1, OUTPUT);
    pinMode(motorPin2, OUTPUT);
    pinMode(enablePin1, OUTPUT);
    pinMode(motorPin3, OUTPUT);
    pinMode(motorPin4, OUTPUT);
    pinMode(enablePin, OUTPUT);
    pinMode(BUZZER, OUTPUT);
    // set enablePin and enablePin high so that motor can turn on:
  }
}
```

Fig. 4: Arduino Programming Window.

Motor Control Android application

In the proposed work, open source android application named as “ARDUINO BLUECONTROL” is shown in figure 5 is developed with the help of MIT app inventor. The app enables the smart phone to communicate with bluetooth module HC-05 and receives the command from the user. The various features are provided in the application for controlling the motor drive. The graphical user interface (GUI) is done with the arrow keys (like up, down, left, right) and buttons. The user can control the trolley with the help of integrated accelerometer in the mobile phone. For example, the right arrow key in GUI is used to give the command to the controller which enables the motor to drive to go patient room 1, upward arrow key is used for room 2 and etc.



Fig. 5: Android Blue Control App.

WICED sense application

WICED smart bluetooth sensor is connected with the controller to monitor the pressure, humidity and temperature. The parameters are monitored by WICED sense android app as shown in figure 6 which is preinstalled in smart phone. The WICED sense smart kit is embed with BCM20737S Bluetooth-SoC and five microelectronic sensors like gyroscope, accelerometer, e-compass, pressure, humidity and temperature. The bluetooth kit connects directly to the sensor with the controller. WICED sense application displays the real-time data from the sensors so that conditioning monitoring is done remotely in nurse station.



Fig. 6: WICED Sense App.

EXPERIMENTAL RESULTS AND DISCUSSIONS

The entire setup as shown in figure 7 is made ready for the operation. The power button is switched ON and for testing purpose, three predefined paths are assumed. On interfacing the device with a smart phone using the bluetooth module HC-05, one can make use of the trolley or device. Three different cases/locations is shown in figure 8 are explained below.

CASE 1: Room 1

When the user instructs the trolley to travel to the room 1, the bluetooth module receives the command and is sends the serial data to the arduino for the further processing. Both the motors rotates in forward direction for 10 seconds and turns left by keeping a left motor off and right motor on for 2 seconds and further proceeds for 10 sec reaching the destination. The timing need to be adjusted according to the distance of the predefined path and also the speed of rotation of motor. It alerts the care taker by drawing the attention with sound produced by the buzzer. The buzzer sound is turned off after 5 sec and the trolley returned to the original position in the same travelled path.

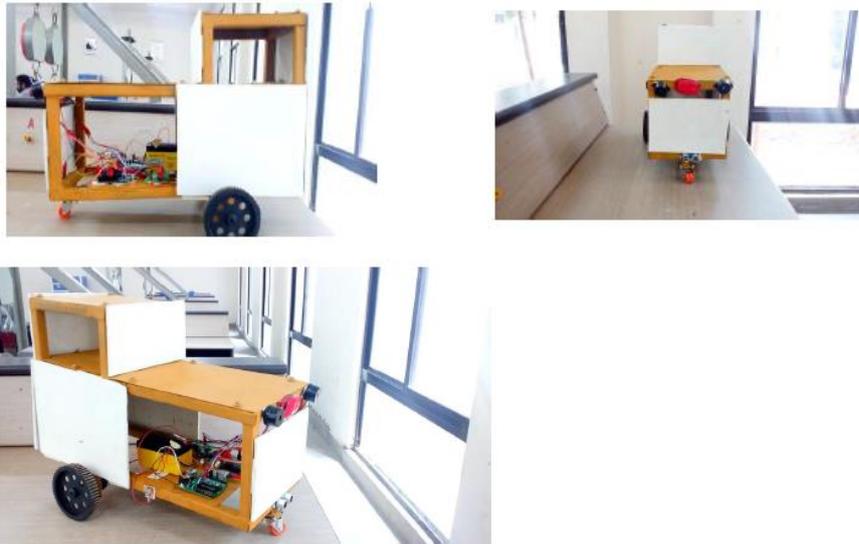


Fig. 7: Proposed Working Model.

CASE 2: Room 2

When the user instructs the trolley to travel to the room 2, the bluetooth module receives the command from the smart phone and sends the serial data to arduino for the further processing. Now the trolley is ready to go to room 2. Both the motors rotate say 15 sec in forward direction reaching the destination. It alerts the care taker by drawing the attention with sound produced by the buzzer. The buzzer sound is turned off after 5 sec and the trolley returned to the original position in the same travelled path.

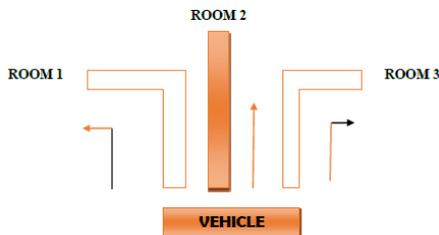


Fig. 8: Predefined Path.

CASE 3: Room 3

When the user instructs the trolley to travel to the room 3, the bluetooth module receives the command and send the serial data to arduino for the further processing. Now the trolley is ready to go to room 3. Both the motors rotate say 10 sec in forward direction and turns right by keeping right motor off and left motor on and again further proceed forward for 10 sec reaching the destination. It alerts the care taker by drawing the attention with beep produced by the buzzer. The buzzer sound is turned off after 5 sec and the trolley returned to the original position in the same travelled path.

In all the cases, the WICED sensor will remain energized which will transfer the environmental parameters to the nurse station wirelessly. Since the trolley is intelligent, it will avoid and alert when there is an obstacle in the predefined path. The effectiveness of the system is based on the quality of motor and type of the battery. The low cost battery like lead acid will drain at very fast rate and the performance of the system will be affected. Li-ion will be the best suitable for driving the trolley.

CONCLUSION

Using simple components available in the market, it is possible to invent new technologies. The developed product is to serve the need in both economic and efficient way for the needy. It is similar to one serving the needy. Here developed a trolley travelling over all places of the centers/hospitals carrying supplies such as food, medicines and other requirements from one place to another place. Keeping in mind to serve the needy in a user-friendly manner, a simple android application is used. This design can also be used in hospitals that makes the people independent to get the needs of patients time to time.

The trolley is used to travel in predefined paths which may require space moving in and around. The trolley mobilization is done on the basis of time which gives the less efficiency than the intelligent trolley. So, the proposed work may be extended by employing intelligence on the trolley in which the trolley is to be trained to mobilize the needs of the patient on time. The proposed model is designed for carrying the weight of 10 Kgs. The same concept may be extended to carry more weight by changing the rating of the motor and battery.

CONFLICT OF INTEREST

There is no conflict of interest.

ACKNOWLEDGEMENTS

None

FINANCIAL DISCLOSURE

None

REFERENCES

- [1] Anuraj NP, Srinivasa, Vignesh Ravichandran [2013] Design of a Food Trolley for Hospitals in India. SASTECH Journal. 12(2): 90-98.
- [2] Theurer VA. [2011] Improving Patient Satisfaction in a Hospital Foodservice System Using Low-Cost Interventions: Determining Whether a Room Service System is the Next Step. All Graduate Reports and Creative Projects. 1(2):32-39.
- [3] Hartwell Heather J, Edwards JSA. [2007] Foodservice in Hospital: Development of a Theoretical Model for Patient Experience and Satisfaction using one Hospital in the UK National Health Service as a Case Study. Journal of Foodservice. 17(6):238-245.
- [4] Hartwell Heather J. [2007] Plate versus Bulk Trolley Food Service in a Hospital: Comparison of Patient's Satisfaction. Journal of Nutrition. 23(3):218-227.
- [5] Hartwell Heather J, Edwards JSA. [2003] A Comparative Analysis of 'Plated' and 'Bulk Trolley' Hospital Food Service Systems. Fourth International Conference on Culinary Arts and Sciences (ICCAS 03). 3(4):133-142.
- [6] Anonymous, Opportunities in Indian Healthcare Industry <http://www.mediminds.co.in/Indian%20Healthcare%20Industry>, retrieved on 12th Nov. 2011.
- [7] Anonymous, Trolley in hospitals. <http://www.jbtc-gv.com/en/Solutions/Industries/Hospital>
- [8] Anonymous, Broadcom bcm9wiced sense. <http://www.mouser.com/new/broadcom/broadcom-bcm9wiced-sense/>
- [9] Anonymous, Hospital AGVS. <http://www.roboticautomation.com/agvs/hospitalagvs>
- [10] Anonymous, Reference. <http://www.arduino.cc/reference>