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Smart Guide for Patients in Hosptial using Microcontroller Interrupts

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***Abstract*— This paper focuses on the problems which arise in the large hospitals when patient arrives in emergency or alone, at that moment patient is not able to deal with the conditions of hospitals in which they have to go from one department to another department for some of the other things, In the whole process most of the time is very stressful as it demands critical time of patient. A smart guided mobile tablet fitted permanently on a wheelchair or on stretcher bed is a very practical solution to resolve this issue. If an injured person just reaches the hospital by own, and unfortunately if no staff members are present at that point in time to help the patient, the patient can use the smart system embedded on wheelchair, to navigate to the emergency ward or the respective department of the hospital without the hassle of any pre-checkup registration. The user can navigate by selecting source and destination from the user interface and can reach the destination easily. The navigation is provided by the microcontroller and interrupts generated from the spokes of the wheel. The patient can use the smart system to enter his/her information to the hospital's database so that the hospital can keep a record of the health and reports of the patients.**

Keywords—GPS, Navigation, Sensors, Microcontroller, Interrupts, Patients, Hospitals, Wheel Chair, Maps, Co-ordinates

I. INTRODUCTION

Smart systems have reached the next level in past years but there is no such a system present or build for hospitals and patients in the hospital for critical situations. There is still manual wheelchairs operating at the big and small hospitals both, therefore the need for a smart system in hospitals has become obligatory. In every hospital when a patient goes in a critical situation sometimes what happens is the patient needs to do the paper formalities which is time-consuming and sometimes there are no ward boys to take them to the particular doctors or guide them which sometimes lead to the death of the patient. This paper proposes the use of Smart System at hospitals which will aim to eliminate all these hurdles and everything will be digitized in a way that patient can put his details online on an app and paper formalities can be done afterward and a smart system will be activated in a wheelchair which will guide the patient to reach the doctor through navigation even Though the ward boy is not present at that particular time to help them out.

In the proposed system the patient will be navigated to the destination using his real-time location of wheel-chair and how far is he from the destination, this will be achieved by using the rotation angle of the wheel, for every rotation the updates will be sent to smart device so that the current location of wheelchair can be updated on user interface on smart system. The entire proposed system is divided into 2 parts:

1. The user interface will contain a map and a pointer showing the current location of Wheelchair and the user will be able to select the Source and Destination From the Dropdown and then the Shortest path algorithm will be used which will to calculate shortest path in between source and the destination, once the path is highlighted by the interface, then the user has to follow the path until he reaches the desired destination, the interface will receive the updates from the hardware sensors and update the location accordingly.
2. The Smart wheelchair is different from other wheelchairs as it has attached microcontroller that will make use of the networking or physical ports to connect to the Interface part of the System. Below figure 1 shows the spokes of the wheel which will have the fixed angle between them, so when the wheels will move the sensor will sense the movement of the spokes either clockwise or anticlockwise, which will then calculate the distance traveled by wheel equal to the arc included between that angle, for every Interrupt generated the signal will be sent to the listening interface and the changes will be made in the Pointer.

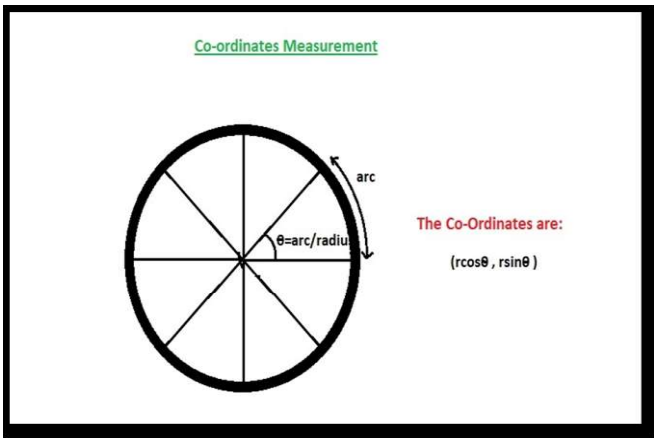


Fig 1: coordinates measurement

II. RELATED WORK

After going through the background of this study we have reported several related work as bellows,

N. Bonzani et al (2016) [1] in his study stated an android application that proposed a new way for indoor navigation in structures like Schools or Hospitals, using NFC readers, because GPS cannot give very accurate results for indoor navigation.

B. Peterson et al (1997) [2] in their study stated the art of the GPS navigation and positioning for outdoor and indoor environments in line with outdoor applications. This paper provides us the basic understanding of the GPS system, GPS Signals and different techniques and methods for the improvement of the GPS System.

H. Piontek et al (2007) [3] stated about the ultrasound pulses, and how they gain greater accuracy in measuring distances. And using this they improved the location update rate by synchronising the active beacons.

H. Liu et al (2007) [4] in his study provided an overview of the wireless indoor positioning system solutions which were in use and also shows the classification of different techniques and solutions. Also various comparisons of the systems are provided on different parameters like accuracy, stability, precision, scalability, robustness and cost.

Jenny Bailey, Jennifer Liddle (2006) [5] in his patent talked about the GPS repeaters unit. The transmitting and receiving of the GPS signals from the satellites and amplification of the received signals before transmitting them to the indoor area.

Arkadiusz Kurek, Jozef Modelski (2007) [6] shown the possibility of using Global positioing system receiver inside the buildings where there is no satellite visibility. And how the system can be used in metro stations or underground parking areas.

X. Zhang et al (2010) [7] proposes a system of additions to navigation in integrated application of new information technology, it is an important component of E-Navigation proposed by the International Maritime Organization. In this article, they have researched from the additions to navigation information dynamic monitoring, transmission, processing, and display, until on AIS and WEB-ECDIS information released by the system of aids to navigation.

F. Ricci et al (2013) [8] stated an easy to deploy lite simple mobile system for indoor navigation in the hospital.They describe a pilot study that helped them select the map layout and they outline the system implementation.

F. Cossu et al (2012) [9] talked about Giving operational help to all clinicians for their daily activities in hospitals wards. Solutions provided in this paper is very usable user interfaces, deployed on mobile devices, and able to enact and monitor the execution of clinical guidelines. they presented a system in which vocal and touch interfaces are being experimented as a suitable solution for clinicians' interaction with the system.

Wen Yao et al (2012) [10] propose a Context-Aware patient Navigation and Engagement (CANE) framework to help in decision making and more efficient use of health care services in hospitals. They have use the BPMN 2.0 workflow language which formalizes the description of navigation processes derived from guidelines of medical and developed healthcare network ontology to help patient in understanding of various clinical activities and operations from multiple perspectives (e.g., resource, logistics, financial, and time).

III. ARCHITECTURE OF PROPOSED SYSTEM

A. Architecture

Fig 2 Shows Architecture of the proposed system and its workflow. In this system Patient will become user of it and will be given a wheelchair to move from source to destination. The hospitals will contain special areas where the wheelchairs have to be placed and aligned in proper direction , thus acting as the source location of the navigation journey .Thus the user will be provided a wheelchair which is at proper location and properly aligned .The wheelchair is attached with a smart tablet that will provide an interface to the user for destination selection . Once the user selects the destination then internal algorithm will calculate the shortest available path among all the available paths from source to the destination.

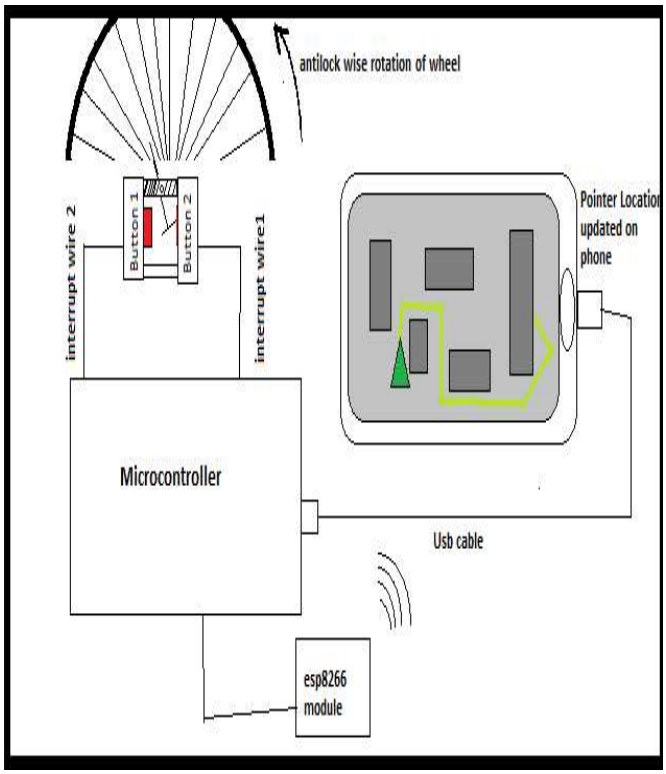
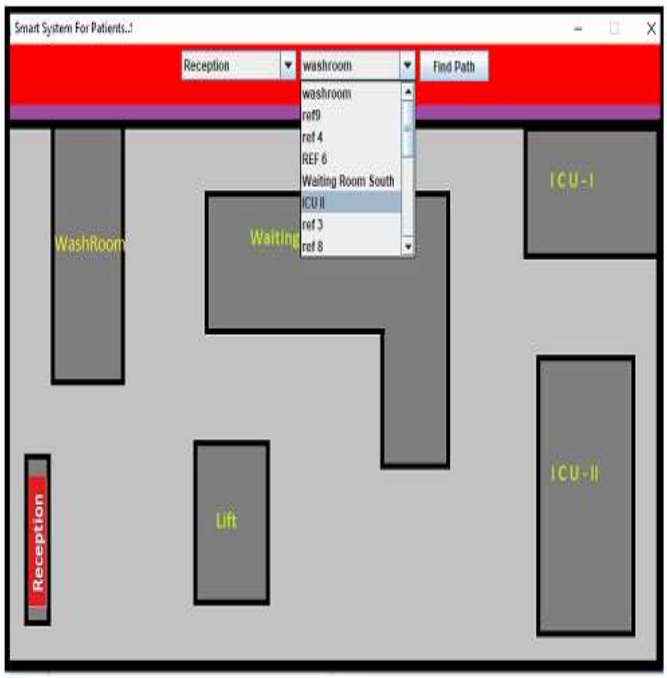


Fig 2: Architecture

B. User Interface

Fig 3 Shows the User interface of proposed system. System user may now start the navigation by moving the wheelchair towards the destination following the path shown by the UI of smart tablet it will also show how far the wheelchair has moved from the initial location in real time like GPS

system. The location will be shown by pointer which will also exactly follow the direction in which user is moving. The system is voice guided which will provide information at regular intervals about how far is he from left or right turn and also the distance remaining.



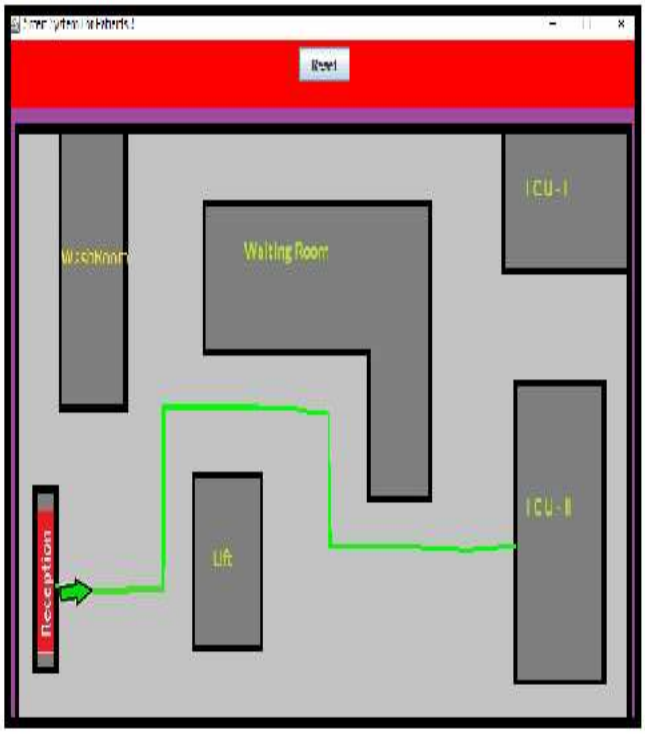


Fig 3. User Interface

If the user moves in another direction the system will alert him of the same and also in such case shortest path checking will be triggered by the system so that he will be provided with shortest path to reach desired destination from the current location of the wheelchair as sensed by the system as shown in Fig 4.

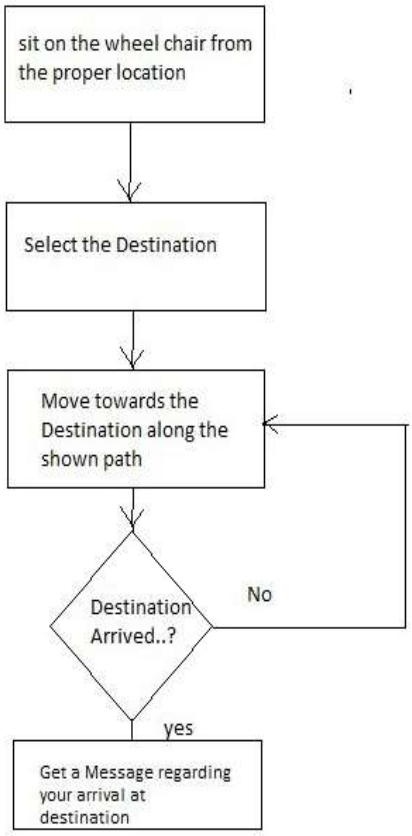


Fig 4: User Interaction Flowchart

IV. COMPONENTS AND ALGORITHM OF SYSTEM

A. Wheel Chair Module

It consists of a switch with 2 buttons that is movable back and front pressing one of the buttons in it. Thus a switch will generate input from each button that will act as the interrupt for microcontroller. Fig 5 shows the switch.

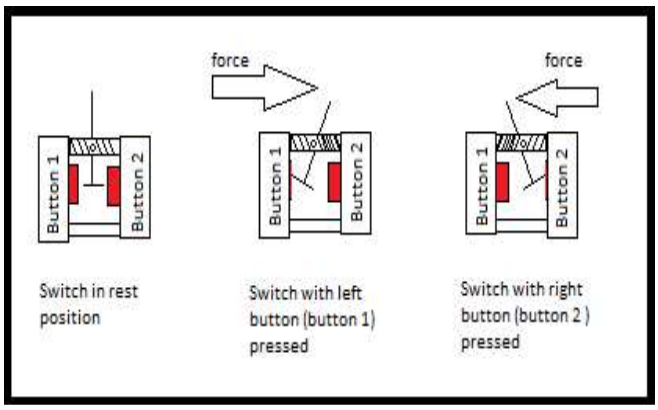


Fig 5: Wheel Chair Module

These switches are located near the wheelchair's wheel such that movable part of the switch lies between two spokes of the wheel thus when the wheel moves antic lock wise the spoke moving left will trigger button 2 generating button 2 interrupt for microcontroller and if it moves in clockwise direction it will generate interrupt from button 1 (refer figure above to understand). Now microcontroller can differentiate between these two interrupts and can sense

whether the wheel rotated clockwise or anticlockwise each wheel will have one switch thus total of 2 switches will be needed for two wheels of wheel chair. The input from the switches will be read by microcontroller, It will then create a data structure with properties such as "wheel identity" and the "direction" based on interrupt generated by switch, assign the values to these variables based on which wheel generated interrupt and whether wheel was moving anticlockwise or clockwise based on the button in switch that generated this interrupt.

For example: let us consider that left wheel generated an interrupt while moving anticlockwise direction thus data structure will be as below.

```
typedef struct
 {
int WheelIdentity=0;//0 for left wheel and 1 for right wheel
int Direction=0;  // 0 for anticlockwise and 1 for clockwise
 };
```

Now, this data will be sent through Universal serial port to the mobile device or the esp8266 module where it will be transmitted wirelessly to the smartphone.

B. Tracker Device

The Smartphone or tablet will receive the data from microcontroller this data will then be used to calculate the new coordinates of the pointer and it will be shown accordingly on screen. Here we know that the angle between the two adjacent spokes is fixed . Now if the map is of size x'km by x'km then we will scale this distance that will fit into our device's screen lets say y'cm by y'cm since 1 km=100000 cm thus to represent every distance in smartphone we will divide the distance in km by 100000 . i.e y=x/100000 here 100000 is scaling factor and it will change depending on the requirement. Thus the distance included between two wheels interpreted on screen will be scaled down to so that it fits on screen. the formula for getting updated coordinates after rotation along origin will be used for calculation of new rotated coordinates which is given as

$$X' = X\cos(\text{angle}) - Y\sin(\text{angle}) \quad (1)$$,

$$Y' = Y\cos(\text{angle}) + X\sin(\text{angle}) \quad (2)$$

Equation 1 and 2 are for clockwise rotation

$$X' = X\cos(\text{angle}) + Y\sin(\text{angle}) \quad (3)$$

$$Y' = Y\cos(\text{angle}) - X\sin(\text{angle}) \quad (4)$$

Equation 3 and 4 are for anticlockwise rotation

The coordinates will first be translated to origin, rotated using above formula and retranslated back from origin to initial place but with rotated coordinates. Where X and Y are initial coordinates and X' and Y' are coordinates after rotation.

Using the above formula the point of the pointer which represents the wheel's location on pointer will be rotated by fixed angle between two adjacent spokes, considering another wheel's point on pointer as center

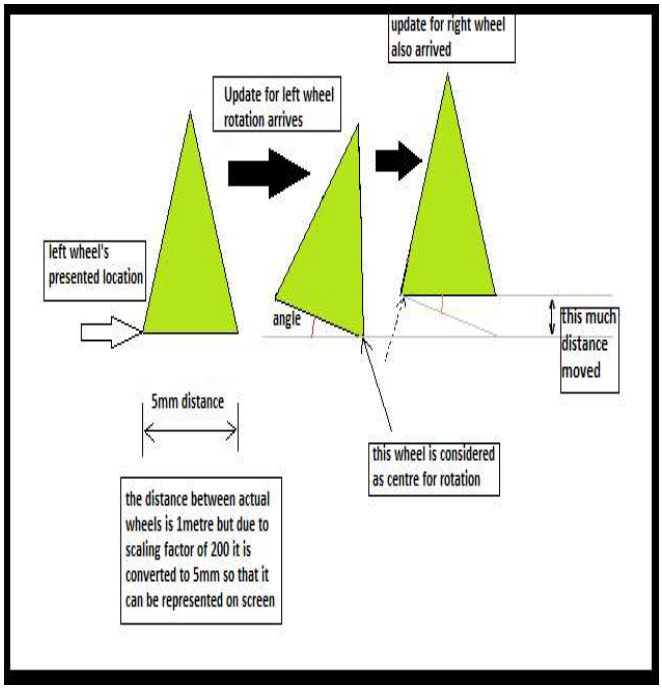


Fig 6: Tracker device

Suppose the wheel is moving in anticlockwise direction, It's spoke will hit the toggle of switch pushing it's right button (button 2 on below figure) this output of pressed button is an interrupt for microcontroller. Microcontroller knows from which wheel interrupt arrived thus assigning wheel identity variable as wheel 0 or 1 for left and right wheel respectively .now the interrupt which is generated is known to microcontroller and thus the direction variable is set 0 or 1 for anticlockwise and clockwise rotation respectively .This data is sent to tracker device either using esp8266 chip wirelessly or through USB cable. The data arrived at tracker device is used to update the pointer by using rotation formula.

V. CONCLUSION

This paper has focused on a smart guiding system using wireless sensor nodes capable of guiding in different environments: hospitals, home, and ambulatory. The system implemented is a real-time guiding system, which guides the patients to respective wards or doctors by knowing their destination. The user has to give some inputs the device and it will navigate the patient to the respective doctor or ward. The user can fill some of basic information on his way to the respective ward. If he or she is heavily injured and if a caretaker is with them, then it will be much handy for them also. This smart guided system is fitted in the wheelchair and the 'smart wheelchair' can be used in case, if any helper or employer is not present at the time of need. So to ease the navigation of the patient to its respective doctor will be too easy and relatively fast with this 'smart wheelchairs'.

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