Human Assisting Robot

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Abstract- Various works are carried out on Human - following robots, for their immense potential to carry out mundane tasks like load carrying and monitoring of target individual through interaction. The recent advancements in vision and sensor technologies have helped in creating more user-friendly robots that are able to coexist with humans by leveraging the sensors for human detection, human movement estimation. But most of these sensors are suitable only for Line of Sight Objects. In case of loss of sight of the target, most of them fail to re-acquire their target. This work proposes a novel method to develop a human following robot using Bluetooth, GPS and Inertial Measurement Unit (IMU) on smartphones which can work under high interference environment and can reacquire the target if the target position is lost.

Keywords- Robotics, Arduino, helping mankind.

I. INTRODUCTION

Recent developments in the robotics world have developed robots and are user friendly, intelligent, and most importantly affordable. With these benefits of robotics, it is no wonder that they have found to be used in every field. The benefits of robots have increased their flexibility with being capable of performing a variety of tasks and applications. Robots also allow for increased production and profit margin because they can complete tasks faster. Robots have the ability to work around the clock since they do not require vacations, sick days, or breaks.

Robots are preferred over men doing the job specifically in hazardous environments, handling toxic substances, working with heavy loads and wherever repetitive tasks are involved.

This work on human assisting robot uses Bluetooth to have communication between the robot and the tag held by the user, here after called target. In this work mobile is used as a tag. Human assisting robots are generally used in hospitals, restaurants and airports, etc [1] to carry luggage. However most of these robots fail to re-acquire their target, if line of sight is lost [2].

This problem can be eliminated using GPS and GPS has the advantage of tracking the robot even its position data is lost. To enable the tracking system on robot, GPS is used along with the GY273 compass which helps in giving appropriate commands to the motor drivers.

The primary goal of our work was to design and fabricate a robot that not only tracks the target but also moves towards it with the help of GPS and compass.

The disadvantage of using the GPS is that it does not work indoor [3].

In this work all the processing is carried out by the Arduino UNO microcontroller and L298N motor drivers are used to drive the motors.

II. PROPOSED SYSTEM

The circuit connection of the proposed system is shown in Fig. (1). It mainly consist of Arduino UNO microcontroller, HMC5883L compass, NEO6m GPS, HC06 Bluetooth module, L298N motor driver, 12 V DC motors and batteries. The three challenges that are faced while assembling above components and making human assisting robot are (i) power consumption for driving the motor and other electronic systems, (ii) control system used to control the robot and (iii) tracking the robot.

To drive the motor 12V battery is used another 9V battery is used to power other electronic modules. For controlling functions Arduino UNO microcontroller which is based on ATmega328P is used. This acts as the brain of entire system. It receives the information from different modules such as compass, GPS etc, and checks information and identifies the location of target. Then it sends the instruction to motor driver for making movements. Then continued tracking is done using the data of GPS Neo 6m and magnetometer GY273. The position is determined by the GPS Neo 6m. Magnetometer GY273 is used to measure the direction of movement of target called heading.

A. Bluetooth connection establishment

The Bluetooth module used here is HC 06. To enable the Bluetooth password is 1234 or 0000. The Bluetooth has 6 pins such as State, Rx, Tx, enable, VCC and GND. The VCC of Bluetooth is connected to 5V of Arduino and GND is connected to GND of Arduino. Rx pin of Bluetooth is connected to the transmitter pin of Arduino and Tx is pin of Bluetooth is connected to the receiver pin of Arduino. The Bluetooth is basically establishes communication between the robot and the human.

B. Compass connection establishment

The compass used here is a magnetometer GY273. Two Way Interface (TWI) connections is established in order to interface it with the Arduino. It contains 5 pins VCC, GND, SCL, SDA and DRDY. VCC and GND connection are same as that of the Bluetooth. Serial Clock (SCL) is connected to the A5 analog pin of Arduino UNO and serial Data (SDA) is connected to the A4 analog pin of the Arduino. The magnetometer is used to determine the heading. The Fig. (2) below shows the connection diagram of the compass.

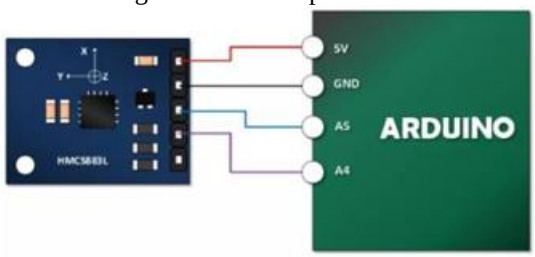

Fig.2: Connection of compass and Arduino UNO [4]

C. GPS connection establishment

This work uses GPS Neo 6m, UART connection is established in order to communicate with the Arduino board. The GPS has got 4 pins VCC and GND is connected as in Fig. (3) and the Rx is connected to the transmitter declared pin the Arduino board and Tx is connected to the receiver declared pin the Arduino. The GPS is used to get the location of the robot.

D. Motor Driver connection

The motor driver used in this project is L298d. the driver has got 4 input pins and 2 enable pins and output ports. The ground connection should be made common with Arduino and the driver. The four input pins are IN1, IN2, IN3 and IN4. These pins are connected to the digital pins of the Arduino. These pins are used to change the direction of the motor. IN1 and IN2 and used for motor1 and IN3 and IN4 are used for motor 2. The two enable pins are used to for speed control. ENA and ENB are the two enable pins for motor1 and motor2 respectively. The enable pins are connected to the PWM pins of the Arduino. The motors are connected to Arduino through motor drivers as the Arduino is not able to drive the required current. 12v Dc motors are used in this work. The connection diagram between L298n motor driver and Arduino is shown in Fig. (4)

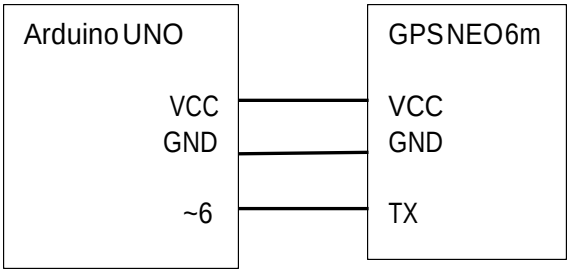

Fig.3: Connection of GPS

Here, we followed systematic approach which means starting from testing of each component to integrating it with other to make it function efficiently. Here each and every sensors and modules communicate among themselves to function efficiently. The above way of functioning is called decentralized approach. In decentralized approach there is no governing body. It is just the modules that work according to the algorithm.

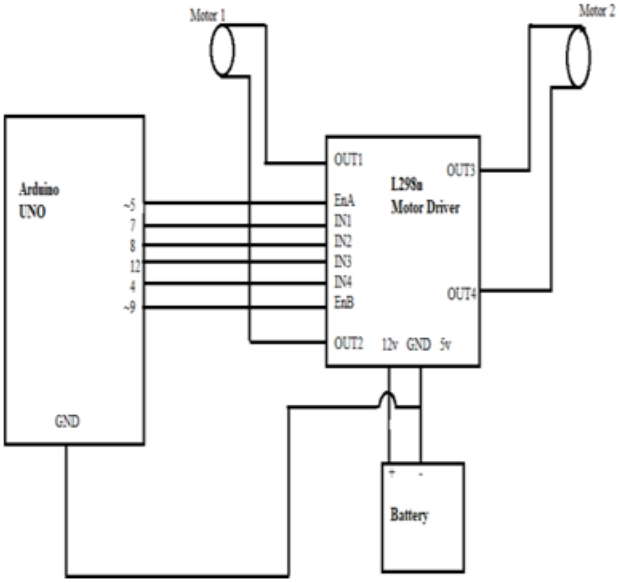

Fig.4: Connection of L298D with Arduino

E. Software Description

The system makes use of Arduino UNO that acts as a central control and processing unit along with Bluetooth to establish a connection between robot and target. The GPS along with compass is used to track or navigate the direction of the tag. Blynk platform is used to control our hardware via cloud using Bluetooth. After, extracting the information about the target, the tracking the target is done by GPS and Compass signals. In, the present prototype forward, backward, left and right turns motions are used to track target. As soon as the Arduino UNO unit receives the direction commands it executes commands provided in the program. Change in direction

happens significantly whenever the target takes turn with respect to the hardware module.

III. METHODOLOGY

In this work there is no governing body, i.e it does not require any human intervention for command or direction. This means all the work is done by the modules interacting among themselves as per the algorithm. Hence we can say that the Autonomous connection is established.

Here Arduino is the brain of the entire system. It collects information from GPS, compass and Blynk platform via Bluetooth and give commands to the motor driver for controlling the robot. Everything starts with the connection with the Bluetooth. As the Bluetooth is connected to the smart phone it means there is a connection established between the target and the robot.

For control and navigation GPS Neo 6m is used along with magnetometer GY273. The Arduino gets the position of the robot and its direction of movement from these modules. For robot movement, DC motors are used. The H bridge motor driver is used to control the speed and the direction of the DC motor. PWM signal is used to control the speed and input pins are used to control the direction.

Whenever there is a change in the direction by the human the Arduino compares the position with and check the new direction with the help of magnetometer. Now it gives information to the motor driver through PWM pulse for changing the direction and follow the master. The algorithm of moving forward and turning is as shown in Fig. (5)

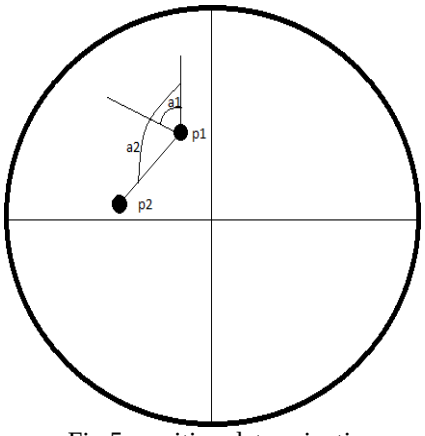

Fig.5: position determination

- Firstly, by using compass the direction is known where it's pointing (p1). So, in relation to the north pole it is called heading represented as a1.
- Secondly, position of android device can be estimated (p2). So, we can find the distance between the two points by using the common formula as:

$$D = \sqrt{(x2-x1)^2-(y2-y1)^2}$$

- Angle between the point p2 and the pole is known as bearing. It can be represented as a2.
- The turn angle can be estimated as : t=a2-a1 or t=bearing-heading
- Turn angle is calculated in order to move towards a particular point or direction.

The flow chart shown in Fig (6) shows the entire functioning of the robot.

IV. RESULTS

As expected the robot functions autonomously, without the intervention of the target / human. The algorithm written into the Arduino helps the robot to follow target by acquiring signals from sensors. Our robot was able to track the human (tag) independent of the direction (Left, Right, and straight) in which he was moving.

V. CONCLUSION

The paper has presented a Human-following robot which is being used for their immense potential to carry out mundane tasks like carrying load and for monitoring of an individual through interaction. However the present prototype is tested only with its movement on different direction and tracking the human who held the tag. In this work mobile is used as a tag. This system works efficiently in outdoor; however it is inefficient in indoors due to poor GPS signal. This work can be further improved by (i) adding obstacle detection sensors, (ii) scaling up the project for carrying weight and (iii) design wheels for moving in terrain surfaces. By adding the above features we can develop this work into product for public / commercial use.

VI. REFERENCES

[1]. V. Alvarez-Santos, X. M. Pardo, R. Iglesias, A. Canedo-Rodriguez, and C. V. Regueiro, " Feature analysis for human recognition and discrimination: Application to a person – following behavior in a mobile robot," Rob.
[2]. Auton. Syst., Vol. 60, no. 8, pp. 1021-1036,2012
[3]. BondaVennaPradeep,E.S.Rahul,Rao R Bhavani, "Follow me robot using bluetooth based position estimation" .1-6,2017
[4]. MHA Hamid, AH Adom, NA, Rahim MHF Rahiman, "Navigation of mobile robot using GPS".1-6, 5th international colloquium on signal processing & its applications(CSPA) 2009.
[5]. http://henrysbench.capnfatz.com
[6]. MD Sarmad Hassan, Mafaz Ali, Ali Fahim, "Design and Development of Human Following Robot" 1- 8,Student research paper conference Vol-2,No-15,july 2015.
[7]. Nicola Belloto and H.Husing, "People Tracking And Identification With Mobile Robot"1-6,proceedings of the 2007 IEEE,International conference on Mechatronics and Automation,2007.

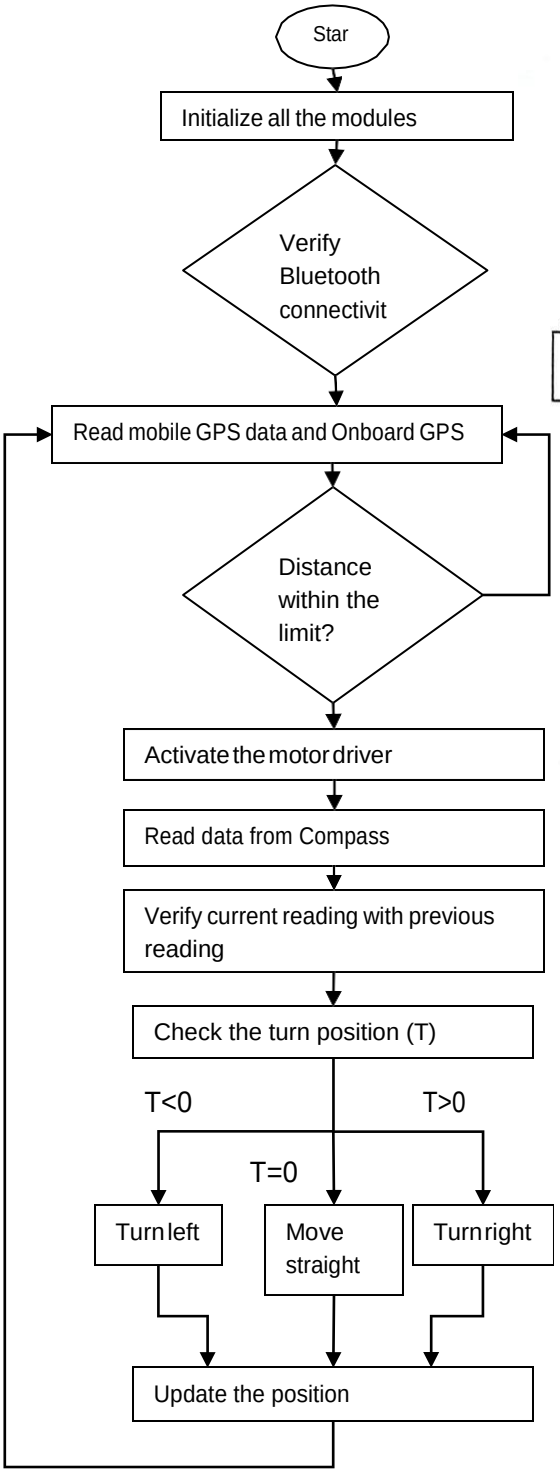

Fig.6: Flow chart of the system

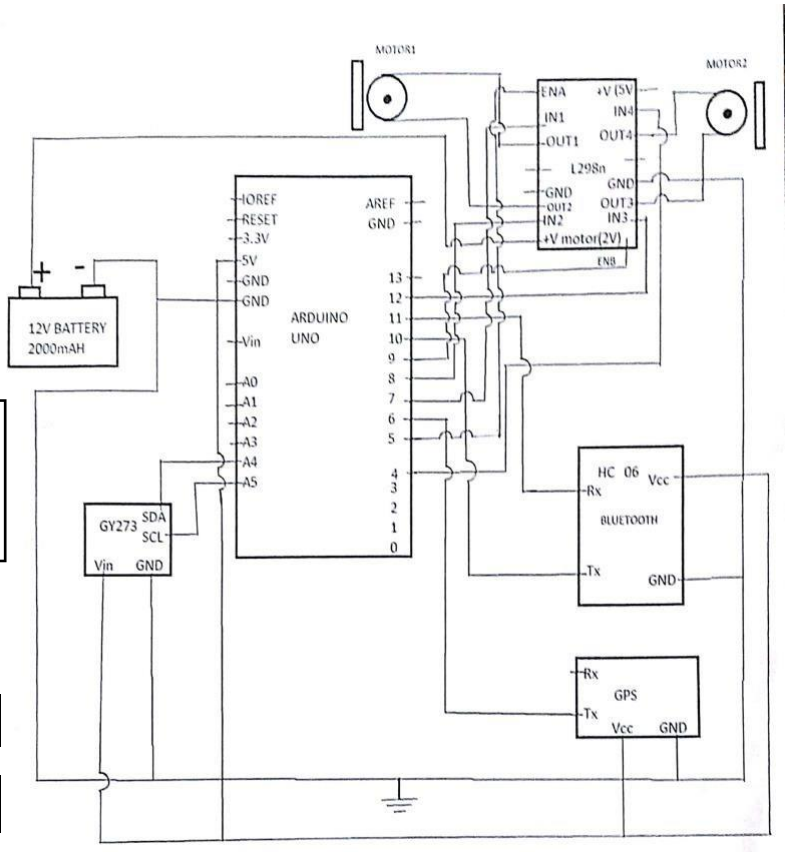

Fig.7: Circuit diagram of the system