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Arduino Based Human Following Robot

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ABSTRACT — The most important factor for an autonomous robot is to have a continuous interaction between the person and the robot itself. The improvement of science and technology has led to many change in our lifestyles.Our project is about a robot that autonomously follows human assisting them providing the necessary help needed. Using the latest technology in most of the applications like robot, military, space research etc. People following ground robots can have applications in military, civil, and domestic settings.Various sensors may be used to detect a person including cameras, infrared, laser, and ultrasonic sensors. This describes the implementation and testing of a robotic cart that iscontrolled via asmartphone application and can be tele-operated, as well as set into a follower mode where it uses ultrasonic sensors to locate the person walking in front of it, and keeps a constant distance, robot is connected with the person by Bluetooth model and track the location using GPS. These technologies detect the relative position between a mobile robot and a human, in this project designing an Ultrasonic sensor approach in detecting the position of a mobile robot and human, which is the basic technique in human follow robot. However, this project will not only discuss a human follow robot, a robot that should help humans with an additional feature that is, following a person according to location detected, which is used to carry the load and move in the desired location of the user. That should help humans in an environment such as Hospitals, Schools, or Shopping malls.

Keywords—Human-following, human-tracking, Wii camera, human robot interaction

I. INTRODUCTION

Robots havebecome more useful in bringing comfort to humans. They areusually used only in heavy industries such as in assembly factories, automations or food processing factories. Human-following robots have been widely researched and developed by many universities and corporation around the world, due to its advantages and useful application in our daily life. Soon, human-following robots will be needed as they are able to support and help us more effectively and efficiently. This gives the advantage for the manufacturer to create more user-friendly that are able to coexist with human and to support them.

The human-following robot can be used in many ways facilitating our daily life activities. For instance, it can help in carrying stuff that usually people might carry such as in hospitals, restaurants, airports… it can also acquire or monitor certain information associated with the human subject. Indoor mobile robots usually battery operated and use adifferential drive mechanism with coaster wheels and variety of sensors.

There are many applications for human following robots, where such robots must localize the walking person and avoid the obstacles. Some examples are: a hospital nurse following a cart with certain carrying capacity and utilizing ultrasonic sensors. A luggage carrying cartthat follows a wheelchair using a special color pattern and an optical vision sensor, an automated shopping cart that uses an ultrasonic and infrared sensors , a following robot that is installed under the shopping cart to move it intelligently, and itis controlled by a smartphone application that guides the cart to the locations of the desired items to be purchased and ,a robotic suitcase that follows the traveller based on wireless communication with a handheld device and embedded shoe sensors a ground robot that follows a marathoner while training is capable of obstacle avoidance and human runner detection using a laser range finder.

Some example technologies employed in follower robots are: a human following robot based on an RGB camera with a depth sensor,a person following robot based on the image processing using a Field Programmable Gate Array (FPGA)

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and an Internet Protocol (IP) camera , a following robot that anticipates human behaviour and can follow the person from behind, the side or the front. It also uses an RGB camera with a depth sensor.

A followingrobot that detects leg movement using a laser range finder.It also uses a camera for face detection. This project describes the development and testing of an electric robotic cart that follows a person and avoids the collision using ultrasonic sensors.It is suited for carrying the loads up at walking speeds, in indoor environments ,where the ground is flat and clean. For example, in warehouses, at airports,or shopping malls.The carts frame construction and anexample user following application(i.e.Supermarket isle) are depicted Fig.1

Fig.1. overview of robotic cart

The user controls the cart viaa smartphone application. It allows the user to make the cart stand still, while loading and unloading, or follow the walking user, in addition to allowing the user to tele-operate the cart via a Bluetooth link. The cart uses ultrasonic sensors to centre itself relative to a person in front of it and keep a constant distancewhile the person walks.

II. RELATED WORKS

A. MARVIN

Researchers at the University Kaiserslautern, Germany has developed a robot and gave it the name MARVIN [5]. The robot main functionality is todetect and follow someone. Ituses atechnique called Sequential Reduced Support Vector Machine (SRSVM). The sensor used is SICK S3000 laser scanner [5] placed at its front side and a LMS200 scanner on its rear side which is used for obstacle avoidance allowing it with the same time to map its surroundings autonomously, the laser scanner is able to detect specifically the human leg. This allowed MARVIN to follow the human based on leg detected. Fig.2 shows the robot MARVIN.

Fig.2. Marvin

Fig.3. HDFM Robot

B. Human Detection and Following Mobile Robot

Human Detection and Following Mobile Robot is developed by a researcher from University of Sciences and Technology, Pakistan [6]. It detects humans by using the 3D features allowing it to follow them. The tracking method used for this robot is Cam Shift theorem. The sensors used are stereo camera andlaser range finder. Fig.3 shows the human detection and following mobile robot. A decentralized top down approach is used for this project. The project is divided into five modules; each module is independent from one another. Different phases were carried out step by step, starting from basic sensor testing and proceeding towards obstacle avoidance, object detection, object tracking and data transmission.

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Two separate units are used i.e. microprocessor and a controller. The processing is carried out by microprocessor and the information obtained by the sensors is controlled by a controller i.e. Arduino board. A serial communication between microprocessor and controller is established to exchange the visual sensing information. Human tracking, obstacle avoidance, maintaining a specific distance from the object and establishing a communication link between microprocessor and controller are the main aspects of this project. In order to make the target distinctive and unambiguous, a tag (Fig.4) was designed in particular. This tag had fourdifferent colors in box arrangement.

The robot should only detect that target and not some other target. This tag is placed on the person that needs to be pursued.

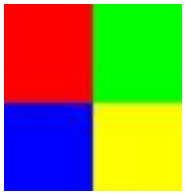

Fig.4. Tag

C. Conclusion and motivation

Existing systems are somehow powerful and complex. However, after studying these systems, some of the disadvantages are to be avoided in our tracking robot. The robot should follow the target with no distraction. IR signal is proposed but similarly to , it is shaped in order to be given a unique identity. The robot, equipped with a wii-camera has a unique target to follow. The speed and the distance between the robot and the target are also tuned by an algorithm to avoid accident.

III. LITERATURE SURVEY

Ng, Yen Leng, Cheng Siong Lim, Kumeresan "Automatic human guided shopping trolley with smart shopping system. " When we speak about human following robots, the cardinal issue that needs to be taken care of is the direction finding of the robot. The direction finding should be such that the robot follows the designated subject only and it should not deviate from its path. and technological advancements have engendered many methods which aim to tackle this issue with maximum possible accuracy. The proposed , application a human following shopping cart, has a similar aim. To gain an in-depth knowledge of the various direction-finding methods that can be used for this application, we studied various research papers [1], that have implemented concepts along similar lines.

K. Morioka, J-H. Lee, and H. Hashimoto, "Human-following mobile robot in a distributed intelligent sensor network," Some other research work was also conducted In this regard, Depth imaging was used by Calisi and the Target was pursued by designing a special algorithm .They did a lot of work on object tracking and detection. The biggest advantage of their method was that their algorithm worked in complex environments as well [2]

J. H. Lee, T. Tsubouchi, K. Yamamoto, and S. Egawa, "People Tracking Using a Robot in Motion with Laser Range Finder," and M. Lindstrom and J. O. Eklundh, "Detecting And tracking moving objects from a mobile platform using a laser range scanner", Different algorithms are being developed by the researchers for the detection purposes. Laser was used in one researchto find the style of the moving legs and a camera was used to detect a object or a person. A very simple technique was also used by researchers. In this technique, the person used distance sensors on the robot and the person. These sensors emitted radio waves and were detected by the sensors on the person to be followed. This way the robotfollowed the required target.[3]

Later on,Leo Louis in his paper, "Working Principle of Arduino and using it as a tool for study and research" tells us that Arduino is a open source microcontroller which can be easily programmed erased and reprogrammed at any instant of time. The Current advanced uses of Arduino also include: Arduino AutoBilling Shopping Trolley, Arduino Fire Detector & Extinguisher Bot, IR Vision Snake Robot-Arduino.[4]

R. Munoz-Salinas, E. Aguirre, and M. García-Silvente, "People detection and tracking using stereo vision and colour"

This method enabled him to peruse the required target with an Effective manner. The combination of different sensors was Used by R. Munoz too. get the information about the target to be tracked. In addition to using different sensors, he also used stereo vision to get accurate information. The data of the sensors combined with the Information from the camera proved to be very helpful in carrying out the task[5].

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In the future, the usage of robots in helping human's tasks would be massive. It will be normal one day to find out that the person following the robot has taken over a simple task, such as being a driver, maid, gardener, or even security guard. It is necessary for human beings to explore robotic knowledge as it knows no boundaries. This projectdescribes a review of a person following robot recent research. Along the way, each system's advantages have been identified.

IV. BLOCK DIAGRAM

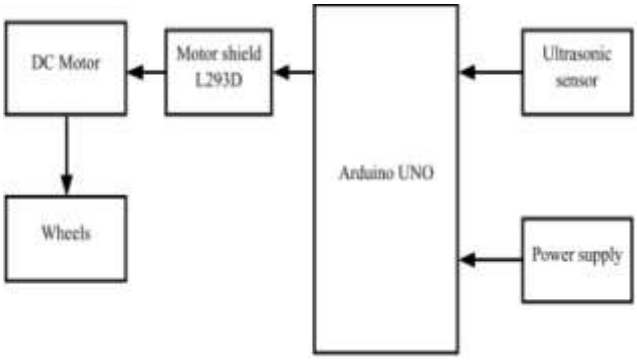
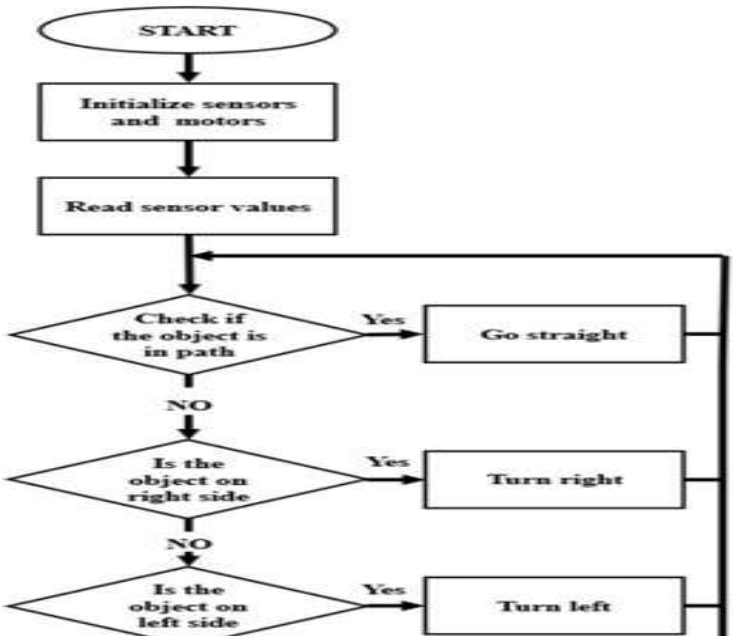


Fig: Block diagram

The fig.shows the proposed system, the human following robot is done with the help of Arduino UNO, ultrasonic sensor and a motor shield. In this Arduino UNO is interfacing with an ultrasonic sensor and motor shield. When the power supply Is ON the three sensors detects the presence of human and it is calculated the distance between human and robot ,if the distance between human and robot is less than 25 cm and greater than 8 cm , the robot starts following human when there is a interrupt occur then the robot stops and then its re-starts following the human . Robotwill be in an active state until the person turns off the power supply .

ArduinoIDE is the open-sourceplatform.The board is connected to a computer via USB, where it connects with theIDE. The user writesthe code in the IDE and then uploads it to the microcontroller which executes the code, interfacing with inputs and outputs. In this way the human following robot follows the human.

V. FLOW CHART



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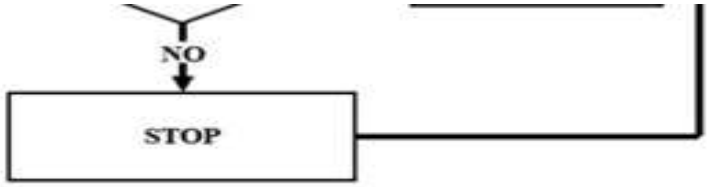
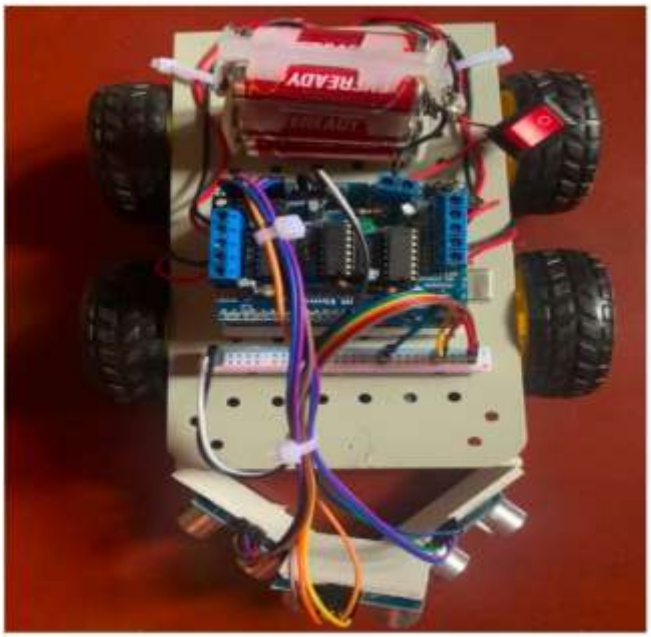


ssssFig : Flow chart

The flow chart to maintain specific distance is shown above. After the ultrasonic sensor is interfaced the magnetometer to get the orientation of the robot in x-y-z coordinates. This Module determines the orientation of the robot and tells the heading direction of the robot. This heading direction is used to determine t he tilt of the robot from its original position. On the basis of information obtained from this module, the control unit determines how much direction change is required to be back on track again after avoiding the obstacle. After interfacing of above sensors, the next most important part of this system design is to interface the encoders to wheel calculate the distance travelled by the robot to eliminate any further error in the robotic movement due to displacement.

For thispurposewe attachedtwo slot sensors on top of the encoders rightbeside the wheels. The slot sensor has anIR transmitter and a photodiode mounted on it and facing each other.The light emitted by the IR LED is blocked because of alternating slots.

VI. EXPECTED OUTCOME



After completing all the stuff according to this connection format, the human Follower robot will be ready to perform. The main difficult thing about this is building an algorithm on which the working behaviour of this robot depends. So, the main object of this phase is to understand the algorithm and the connection diagram. In thisproject, the human following robot has been made to follow the human. This robot has an ultrasonic sensor which detects the object and sends the information to the Arduino and motor driver which control the process of the wheels and microcontroller controls the whole operation. The human following robot will be lastly finished.

VII. CONCLUSION

Arduino is the main functioning tool in this project. This robot has an ultrasonic sensor which detects the object and sends the information to the Arduino and motor driver which controls the process of the wheels and microcontroller the whole operation. It will automatically be run with tracking a human.This robot is affordable but highly effective for the different purpose. The proposed system was to design and construct cost-effective, reliable to follow the human and helps in many fields in carrying loads.

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