HUMAN FOLLOWING ROBOT

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Abstract - *The Robotic industry has evolved so much and has been a revolutionary in helping human beings to complete certain tasks . Without the help*

of industrial robotics to produce cars , cellphones or a computer , production will suffer as time is a very important factor for businesses. Each year, there will be new findings to create a robot that may one day behave similarly like a human being. However, this paper will only discuss the robot following the person, a robot that should help humans in an environment such as hospitals, schools, or shopping malls. Robots that function fully autonomously should not only complete the jobs that are desired of them but also somehow establish a connection between themselves and the person operating them. In order for a robot to communicate and interact with the person, it should also be capable of following that particular person. Keeping this in mind, there should be a capacity in the robot to get information from the surroundings while pursuing the required object. The primary goal of our work was to design and fabricate a robot that not only tracks the target but also moves towards it while doing the tracking.

Keywords- *robot , person , ultrasonic sensor.*

1. INTRODUCTION

Robotic technology has increased appreciably in the past couple of years. Such innovations were only a dream for some people a couple of years back. But in this rapidly moving world, now there is a need for robots such as "A Human Following Robot" that can interact and co-exist with them. To perform this task accurately, a robot needs a mechanism that enables it to visualize the person and act accordingly. The robot must be intelligent enough to follow a person in crowded areas, vivid environments and in indoors and outdoors places.

The image processing carried out to get the information about the surroundings visually is a very important thing. The following points should be carefully noted while doing the processing.

- *The luminosity conditions should be very stable and should not fluctuate.*
- *The ranges should be set properly for the desired environment on which to perform the tracking.*
- *The target should not be very far from the visual sensor as the distance matters a lot.*
- *We should avoid the use of such colors around the robot that matches with that of the target. Otherwise the robot would get confused.*

Typically human following robots are equipped with several different diverse combination of sensors i.e. light detection and ranging sensor, radio frequency identification module (RFID), laser range finder (LFR),

infrared (IR) sensing modules, thermal imaging sensors, camera, wireless transmitter/receiver etc. for recognition and locating the target. All the sensors and modules work in unison to detect and follow the target.

The capability of a robot to track and follow a moving object can be used for several purposes.

- *Ø To help humans.*
- *Ø To create ease for people.*
- *Ø Can be used for defence purposes.*

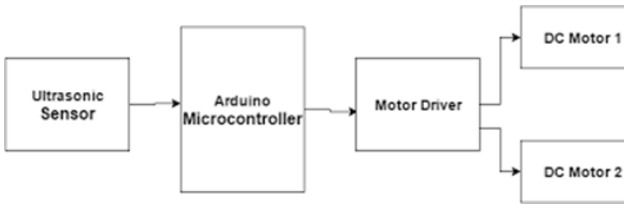
In this paper, we presented a method of a human following robot based on tag identification and detection by using a camera. Intelligent tracking of specified targets is carried out by the use of different sensors and modules i.e. ultrasonic sensor, magnetometer, infrared sensors and camera. An intelligent decision is being made by the robot control unit based on the information obtained from the above sensors and modules, hence finding and tracking the particular object by avoiding the obstacles and without collision with the target.

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.

Due to the decentralized approach, all modules and sensors act independently. Data obtained by different sensors and modules is collectively analyzed and an intelligent decision on the basis of information obtained is made that instructs the robot to follow a particular direction. 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.

This approach was most suitable because if there is a fault in any one of the modules then it would not affect the entire system. Hence this provides the best possible results by maintaining accuracy.

Human tracking, obstacle avoidance, maintaining a specific distance from the object and establishing communication links between microprocessor and controller are the main aspects of this project.



Block Diagram

2. LITERATURE REVIEW

In the field of unmanned vehicle (UV) systems, researchers have been striving to inverse the human-robot ratio such that one operator can control multiple robots. This goal has not yet been accomplished for military applications, despite ongoing research. Research suggests that the human-robot interaction (HRI) that takes place while an operator is in control of one or more UVs needs to be improved before the ratio can be inverted. This literature review included 53 references to provide an overview of current HRI research dealing with the operation of UVs and to identify the key human factors (HF) issues when conducting research within this area. The literature identified three key factors in HRI research related to operating UVs for military applications: operator capacity (that is, the number and type of UVs that a human operator controls or supervises), automation, and interface design. Within the literature HRI is most often measured through the three common metrics of situation awareness (SA), workload, and task performance. In general, research shows that increasing operator capacity increases workload and decreases SA, while the corresponding impact on performance has been shown to be inconsistent. Automation and multimodal interfaces have been shown to alleviate some of the increased workload and decreased SA as operator capacity is increased, however, there is a complex interaction between the three variables. The literature suggests that adaptive automation and adaptive interfaces are promising solutions to accommodate for this complex interaction, but further research and empirical studies are necessary before they can be implemented into military operations. Three additional characteristics of military applications also need to be investigated further: one operator in control of mixed UV platforms (i.e. UAVs and UGVs), operators controlling UVs in a mobile environment, and team coordination between multiple operators each in control of multiple UVs. To help further research in this area, the new Human-Robot Interaction laboratory being built at DRDC—Toronto should consider investigating HF issues in the design of a multimodal adaptive interface for mixed UV military operations. In particular, due to gaps in the literature and the need for more detailed research in certain areas,

studies should look at the interactions between operator capacity, adaptive automation, automation reliability, adaptive interfaces, mobile environments, and team coordination.

3. COMPONENTS USED

Hardware Components Used:

1. Arduino Uno:

Figure 3.1: Arduino uno

Features:

- *ATmega328P microcontroller*
- *Input voltage - 7-12V*
- *14 Digital I/O Pins (6 PWM outputs)*
- *6 Analog Inputs*
- *32k Flash Memory*
- *16Mhz Clock Speed*

ATmega328P:

- *8-bit microcontroller*
- *8KB ROM*
- *256 bytes RAM*
- *3 timers*
- *32 I/O pins*
- *1 serial port*
- *8 interrupt sources*

Arduino *is an open-source electronics platform based on easy-to-**use** hardware and software. **Arduino** boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output activating a motor, turning on an LED, publishing something online.*

2. Servo Motor:

Figure 3.2: Servo Motor

This type of motor is basically a brushed DC motor with some form of positional feedback control connected to the rotor shaft. They are connected to and controlled by a PWM type controller and are mainly used in positional control systems and radio-controlled models.

3. Ultrasonic Sensor:

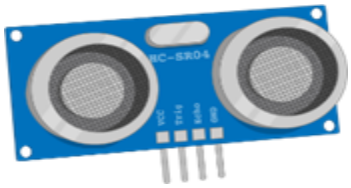


Figure 3.3: Ultrasonic Sensor HCSR04

*An **ultrasonic sensor** is an electronic device that measures the distance of a target object by emitting **ultrasonic** sound waves, and converts the reflected sound into an electrical signal.*

- *Ultrasonic sensor has a transmitter and receiver*
- *Frequency is 44KHz*
- *Speed of Sound waves is 340m/s*
- *Distance can be calculated as Speed x Time / 2*

4. Power Supply:

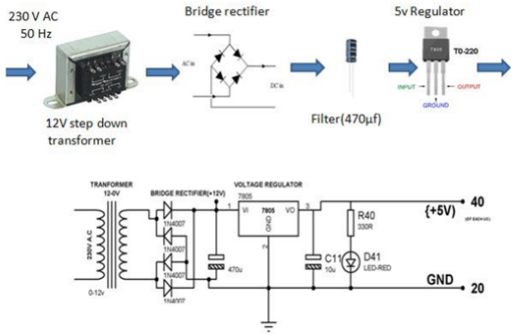


Figure 3.4: Power Supply

5. Motor Driver IC:

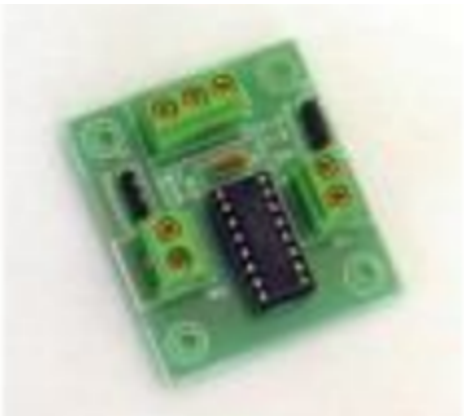


Figure 3.5: Motor Driver IC

This Motor Driver Board is designed to Work with L293D IC. This can control 2 DC Motors, their direction using control lines and their speed using PWM.

6. Gear Motor:

Figure 3.6: Gear Motor

A gearmotor is an all-in-one combination of an electric motor and a gearbox. This makes it a simple, cost-effective solution for high-torque, low-speed

applications because it combines a motor with a gear reducer system.

Software Components Used:

- *Tool Arduino IDE*
- *Programming languages used Embedded C/C++*

WORKING

The system design consists of a separate processing use of a camera and is linked with the control unit to serially transmit the visual information after bulk processing. The control unit is serially linked with the processor and it makes use of several sensors and modules i.e. ultrasonic sensor, magnetometer and infrared sensors Looking at the working of the above system, the first phase is the detection of a tag by means of a camera and carrying out the substantial processing in the processing unit.. After the detection of a tag, the next phase is to establish a serial communication between the processor and control unit. We have used Arduino as a control unit. In this phase centre point coordinates of the tag are serially transmitted to Arduino for further processing.

Next phase is to interface modules and necessary sensors with the control unit. For this purpose, we used ultrasonic sensors, magnetometer and IR sensors for the proper functioning of robots.

We used ultrasonic sensors for obstacle avoidance and to maintain a specific distance for the object. The ultrasonic sensor works accurately within a range 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. The slot sensor has an IR transmitter and a photodiode mounted on it and facing each other. The light emitted by the IR LED is blocked because of alternating slots.

4. ADVANTAGES & APPLICATIONS

Advantages:

*It can **follow** a **human** whenever the person moves in that direction. The **robot** should also be able to exhibit an effective obstacle avoidance with*

*target **following** and exploration behaviours. The **human follower robot** can help us in domestic environments as well as in an industrial area.*

- *These types of robot movement are usually automatic.*
- *The system in the robot is like once installed and forgotten.*
- *It's relatively cheap.*
- *This type of robot is simple to build.*
- *They can also be used for long distances.*

Disadvantages:

*Onto the **downsides of robots**. Here are the **robotics disadvantages** that aren't quite as enjoyable.*

- *They lead humans to lose their jobs.*
- *They need constant power.*
- *They are restricted to their constant programming.*
- *They perform relatively few tasks.*

Applications:

Some applications of this robot are-

- *Can assist in carrying loads for people working in hospitals,libraries, airports..*
- *Can service people at shopping centers or public areas.*
- *Can assist elderly people, special children and babies.*
- *Can follow a particular Vehicle.*
- *In hotels they are being used for the transfer of things from one place to another following a straight path.*

5. FLOW DIAGRAM

- *Designed human follower robot using Arduino microcontroller.*
- *It can follow a human whenever he moves in a straight line.*

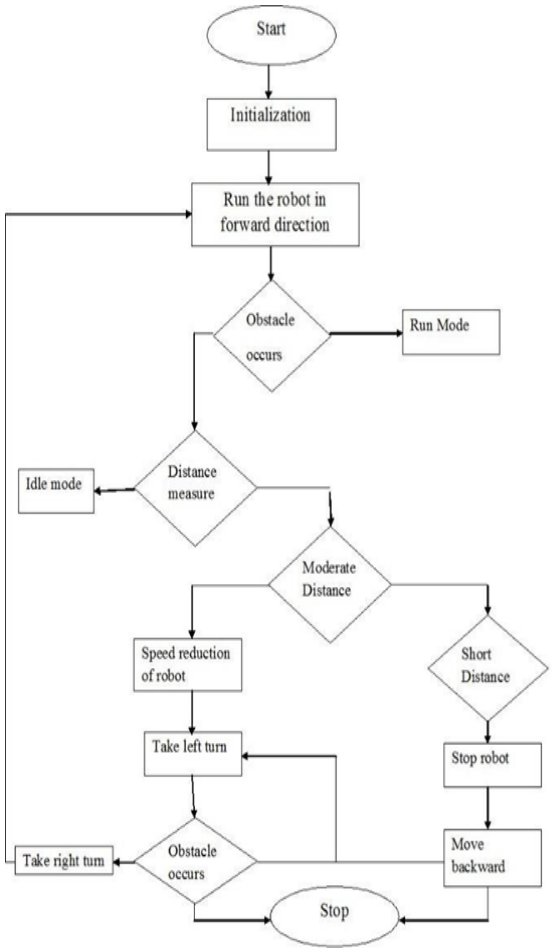


Figure 6.1:Human Following Robot(Flow Chart)

6. REFERENCES

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