Designing of Obstacle Avoidance Robot using Arduino Programming

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Abstract---The obstacle avoidance robots are advanced robots which have the capability to detect obstacles through sensors and move forward without collision. The basic tool for achieving this is "control theory", which deals with the question of how dynamical systems, i.e., systems whose behaviors change over time, can be effectively influenced. This paper treats the navigation problem of mobile robots to avoid obstacles according to vision information. In present method, first detection of obstacles which exist in front of a mobile is done by robot by calculating the optical flow. Then, based on the area of detection the optimal trajectory for a robot is decided. The sensor data for supporting a vision system has been used. In order to find the optimal trajectory, the distance between a mobile robot and obstacle evaluating a function is calculated. In this paper we designed a microcontroller on the board programmed with Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. This obstacle controlled Robots are a great boon to the society because of their versatility, and easy maneuvering capability

I. Introduction

There have been many accounts of user-configurable automated devices and even automata resembling animals and humans, designed primarily as entertainment since ages. A robot is a modern day invention, a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be autonomous or semi-autonomous and range from humanoids. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. The evolution robots are synchronized with the development of Science and Technology is it in the field of Electronics, Computer Science, and Nano Technology etc. Electronics evolved into the driving force of development with the advent of the first electronic autonomous robots created by William Grey Walter in Bristol, England in 1948. The first digital and programmable robot was invented by George Devol in 1954 and was named the Unimate.

The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. These robots have also created a newer branch of robotics- Soft robotics.

A. Meaning of Robot

The word robot, which was introduced to the public by Czech writer Karel Čapek in his play R.U.R. (Rossum's Universal Robots), which was published in 1920. It comes from the Slavic word robot, which means labor.

According to the Encyclopedia Britannica a robot is "any automatically operated machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner.

B. History of Robot

The idea of automata originates in the mythologies of many cultures around the world. Engineers and inventors from ancient civilizations, including Ancient China, Ancient Greece, and Ptolemaic Egypt, attempted to build self-operating machines, some resembling animals and humans.

In ancient Greece, the Greek engineer Ctesibius (c. 270 BC) "applied a knowledge of pneumatics and hydraulics to produce the first organ and water clocks with moving figures.In the 4th century BC, the Greek mathematician Archytas of Tarentum postulated a mechanical steam-operated bird he called "The Pigeon". Hero of Alexandria (10–70 AD), a Greek mathematician and inventor, created numerous user-configurable automated devices, and described machines powered by air pressure, steam and water. The 11th century Lokapannatti tells of how the Buddha's relics were protected by mechanical robots (bhutavahanayanta), from the kingdom of Roma visaya (Rome); until they were disarmed by King Ashoka.

In ancient China, the 3rd century text of the Lie Zi describes an account of humanoid automata, involving a much earlier encounter between Chinese emperor King Mu of Zhou and a mechanical engineer known as Yan Shi, an 'artificer'. Yan Shi proudly presented the king with a life-size, human-shaped figure of his mechanical 'handiwork' made of leather, wood, and artificial organs. In Renaissance Italy, Leonardo da Vinci (1452–1519) sketched plans for a humanoid robot around 1495. Da Vinci's notebooks, rediscovered in the 1950s, contained detailed drawings of a mechanical knight now known as Leonardo's robot, able to sit up, wave its arms and move its head and jaw. The design was probably based on anatomical research recorded in his Vitruvian Man. It is not known whether he attempted to build it.

II. Literature Review

Autonomous obstacle avoidance technology is the best way to embody the feature of robot strong intelligence in intelligent robot navigation system. In order to solve the problem of autonomous obstacle avoidance of mobile robot, an intelligent model is used adopting multi-sensor data fusion technology and obstacle avoidance algorithm based on fuzzy control. Its perceptual system is composed of ultrasonic sensors to detect the surrounding environment from different angles, enhancing the reliability of the system on the base of redundant data between sensors, and expanding the performance of individual sensors with its complementary data, a machine-vision based obstacle avoidance system for robot system by using single camera is

proposed, it could accomplished an obstacle avoidance and path planning [1].

In this project our robot senses any obstacle in its path, avoids it and resumes its running. It involves the pre-computation of an obstacle-free path which a controller guides the robot. Autonomous obstacle avoidance technology is the best way to embody the feature of robot strong intelligence in intelligent robot navigation system. The robot can avoid obstacles with a better security path to solve the problems of mobile robot intelligent obstacle avoidance system. The design of mobile avoidance obstacle system has a good navigation effect because of its advanced characteristics of adaptability, stability and robustness [2].

Mobile robot has been a major role to the application in military, industrial and agricultural purposes. Mobile robot should navigate through desire route and avoid the obstacle within the path. Many researcher come with the solution by using the various type of control and instrumentation system. The complexity of mobile robot system can make the system cost intensive and high risk. The combination GPS and sonar will determine the position and obstacle avoidance for the mobile robot. Mobile robot should navigate according to waypoint that preset to the GPS module and sonar sensor detects the obstacle during mobile robot navigation by triggering the sonar sensor in sequence by using commanded loop daisy chaining application method. Mobile robot can navigate through desired waypoint and at the same time apply the obstacle avoidance rules [3].

In mimicking the process of obstacle avoidance behavior of human locomotion, a combination of basic reflex actions and higher level logical decisions is implemented. For reflective navigation of autonomous mobile robots, the ability to reflectively avoid obstacles on one side only is sufficient for avoidance of obstacle on both sides. When combined with a free-target-approach behavior, the robot can be made capable of navigating through environments with unknown obstacles towards a desired target. Use of this behavior segmentation provides a basis for a compact representation of the reflex behavior as well as allows a concept of virtual-target-side to solve the limit cycle problems, which is common in reflective navigation [4].

Reactive control of a wheeled mobile robot motion in an unknown environment with obstacles is given in this paper. The model of the vehicle has two driving wheels with angular velocity controlled separately. When the vehicle is moving towards the target and the sensors detect an obstacle, an avoiding strategy is necessary. A reactive navigation strategy of collision-free motion in an unknown environment with obstacles is proposed. Then the fuzzy reactive control of a wheeled mobile robot motion in an unknown environment with obstacles is proposed. Output of the fuzzy controller is the angular speed difference between the left and right wheels (wheel angular speed correction) of the vehicle. The simulation results show the effectiveness and the validity of the obstacle avoidance behavior in an unknown environment of the proposed fuzzy control strategy [5].

A new dynamic obstacle avoidance approach for nonholonomic mobile robots in dynamic environments is presented. In dynamic environments, the mobile robot is expected to encounter and safely avoid the obstacles along its way. This will delay the mobile robot in keeping to its original planned timeframe. Addressing this scenario, the proposed approach will ensure the mobile robot is able to gain the time lost during obstacle avoidance and reach the final point at the specified time. Its approach is based on the dynamic trajectory planning scheme which utilized the re-planning approach in order to avoid the obstacle. The performance of the proposed approach is tested through simulations in a simplified city-like dynamic environment [6].

A fuzzy controller is designed for an autonomous robot. The controller has the capability for obstacle avoidance by using negative fuzzy rules in conjunction with traditional positive ones. Negative fuzzy rules prescribe actions to be avoided rather than performed. A rule base of positive rules is specified by an expert for directing the robot to the target in the absence of obstacles, while a rule base of negative rules is experimentally determined from operation of the robot in the presence of obstacles. The consequents of the negative-rule system are codified into a chromosome, and this chromosome is evolved using an evolutionary algorithm. The resulting PIN fuzzy system has fewer rules than would be necessary for an obstacle avoidance controller using purely positive rules, while in addition retaining greater interpretability [7].

III. PROPOSED METHODOLOGY

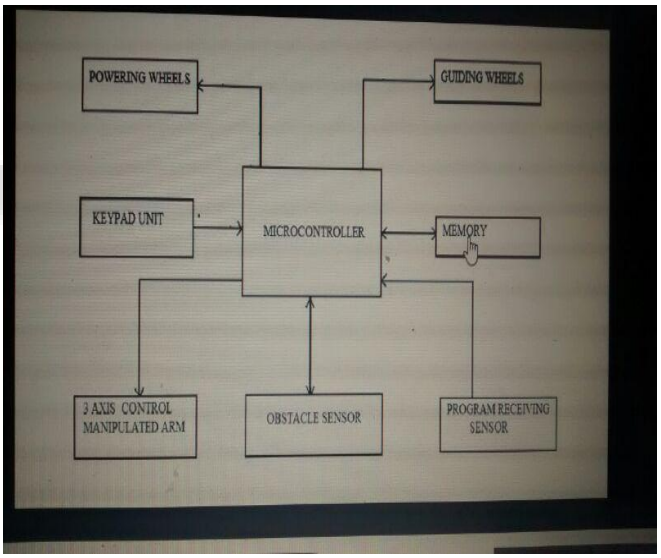

Fig. 1: Block diagram of the system

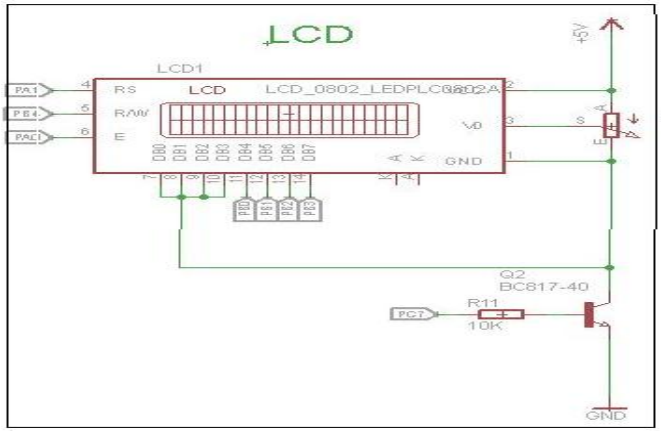

Fig. 2: Circuit diagram

A. Components and Functions

- IR Sensor(Transmitter and receiver)- two for left and right side
- Driver IC(1319)
- Block diagram:- shown
- Circuit Diagram:- shown
- IR Sensor:- sensors based on reflected amplitude of the surrounding objects Non-linear and depends on the reflectance characteristics of the object surface IR sensors able to accurately measure distances with reduced response times
- IR Sensor:- ACTIVE INFRARED SENSORS Break Beam Sensors Reflectance Sensors
- IR Transmitter and receiver:- About: Mainly used to generate IR signal Uses timer IC555 in a stable multi vibrator mode to generate square wave Continuous pulses of 50% duty cycle of frequency 38 KHz
- IR Sensor:- Application: Widely used for distance measurement purposes, Surface feature detection, Barcode decoding, As a tracking system
- Microcontroller(8051):- Single integrated circuit containing a processor core, memory, and programmable input/output peripherals Program memory in the form of NOR flash or OTPROM is also often included on chip Microcontrollers are used in automatically controlled products and devices Make it economical to digitally control even more devices and processes
- Driver(L293D):- About: The L293D is a quadruple half H-bridge bidirectional motor driver IC Can drive current of up to 600mA with voltage range of 4.5 to 36 volts Drive small DC-Geared motors, bipolar stepper motor
- D.C Motor:- Stepper Motor D.C Geared Motor
- D.C Geared Motor: Free running torque & current are ideally zero Increased load implies, increased torque, current drawn & power consumption, Power supplied by a motor is the product of output shaft's rotational velocity & torque, Can run in both directions
- Stepper motor: Used for measured rotation Can be held at a particular position of the shaft Ideal for many autonomous robots requiring higher precision

Fig. 3: Over view of the system

IV. Result and Discussion

The boards can be built by hand or purchased preassembled; the software can be downloaded for free. The hardware reference designs (CAD files) are available under an open-source license. The structure of this system is using a camera and two projectors fixed on same base. When robot gets into a unknown environment, it will stop and capture an image, the system use several simple image process steps to recognize the obstacle. Obstacle avoidance robots find numerous applications , some are described in the following:

- Military can use a variety of weapons with some degree of autonomy in battleground situations if they are equipped with obstacle avoidance system.
- Drilling, long wall and rock breaking machines are now also available as autonomous robots. If they are equipped with obstacle avoidance system , they can autonomously execute a drilling plan on a drilling rig, moving the rig into position using GPS, set up the drill rig and drill down to specified depths.
- Healthcare**:** Obstacle avoidance Robots in healthcare can have two main functions. Those which assist an individual, such as using electric wheel chair, in hospitals. Robots have developed over time from simple basic robotic assistants, such as the Handyi 1 through to semi-autonomous robots, such as FRIEND which can assist the elderly and disabled with common tasks.
- Automated guided vehicles (AGVs) Mobile robots, following markers or wires in the floor, or using vision or lasers, are used to transport goods around large facilities, such as warehouses, container ports, or hospitals. Intelligent AGVs (i-AGVs) Such as Smart Loader, Speci Minder, ADAM, Tug, Eskorta and MT 400 with motility are designed for people-friendly workspaces. Obstacle avoidance increases the proficiency.

Here, in the build circuit the Bluetooth controller plays its role by connecting the Bluetooth installed android device and the Arduino microcontroller. The Bluetooth controller is programmed with a name and enabled to configure and get paired with other devices. For security purposes the pass code can also be build. The android device that is connecting to the home automation device is installed with the application that can connect with any open hardware and send signal to it. This application can send only two signals either on or off to the Arduino devices and this will triggers the relay module which in alternates the state of the electrical device.

V. Conclusion

Various techniques have emerged to develop the science of robotics and robots. One method is evolutionary robotics, in which a number of differing robots are submitted to tests like obstacle avoidance system. Those which perform best are used as a model to create a subsequent "generation" of robots. There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising unemployment as they replace workers in some functions. The use of robots in military combat raises ethical concerns. Fears and concerns about robots have been repeatedly expressed in a wide range of books and films. A common theme is the development of a master race of conscious and highly intelligent robots, motivated to take over or destroy the human race. (Some fictional robots are programmed to kill and destroy; others gain superhuman intelligence and abilities by upgrading their own software and hardware.)

The self-awareness as depicted in science-fiction is probably unlikely, but that there were other potential hazards and pitfalls, therefore, ethical use of Robots is necessary for the betterment of mankind. The obstacle controlled Robot is a revolution in the development of Science and Technology.

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