Development Of Autonomous Robot For Menace Area In Manufacturing Facilities

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Abstract- *The robot works with the instruction of embedded artificial intelligent in the microcontroller. In this study two IR pairs (infrared sensors) are used for avoiding the obstacle on the path of movement of robot. When the infrared sensor detect any obstacle then artificial intelligent will decide the direction of robot movement. 2-infrared sensors on the bottom for detect obstacle, when the sensors detected obstacle, output of comparator, LM324 is low logic and the other the output is high. Microcontroller and motor driver were used to control direction and speed of motor. The robot moves forward autonomously towards the fire. During the movement of robot towards the fire if any obstacles on arise the 2-IR pairs placed in the bumper of robot to detect obstacles. There by IR sensors sends signal to the microcontroller about the presence of obstacle on the path. If it detects the obstacle then the embedded artificial intelligence starts working and the robot works autonomously.*

Keywords- IR sensor, LM324, Pic Microcontroller.

I. INTRODUCTION

The word "robot" coined from the Czech word for forced labor. Robots are electronic devices proposed to perform an anticipated task. Many refer to them as "machines", however, a drill press is a machine, yet it requires an operator to perform its function, where robots can be programmed to do it themselves. Robots have the potential to change our economy, our health, our standard of living, our knowledge and the world in which we live. As the technology progresses, we are finding new ways to use robots. Each new use brings new hope and possibilities, but also potential dangers and risks. Robotics is not only a science, but it is also an art. A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robots are especially desirable for certain work functions because, unlike humans, they never get tired; they can work in physical conditions that are uncomfortable or even dangerous; they can operate in airless conditions; they do not get bored by repetition; and they cannot be distracted from the task at hand. This article is based on the research project which is an autonomous robot to be use in food industry. The robot is powerful, reliable and can be used in hot temperature area where a human after working for so long can become sick and exhausted. The existing demand of robots is increasing to do repetitive work and avoid life risk jobs, such as bomb diffusion, industrial operations, household tasks, etc. Although the appearance and capabilities of robots vary vastly, all robots share the features of a mechanical, movable structure under some form of control. The control of robot involves three distinct phases: perception, processing and action. Generally, the sensors mounted on the robot, processing is done by the on-board microcontroller or processor, and the task (action) is performed using motors or with some other actuators.

Artificial Intelligence (AI) is the information showed by apparatus or programming. It is furthermore the name of the educational ground of learning which thinks how to make computer and computer programming that shows smart conduct. The central questions (or targets) of AI research join thinking, data, sorting out, learning, brand control language (correspondence), perception and the ability to move and control objects.

II. BLOCK DIAGRAM

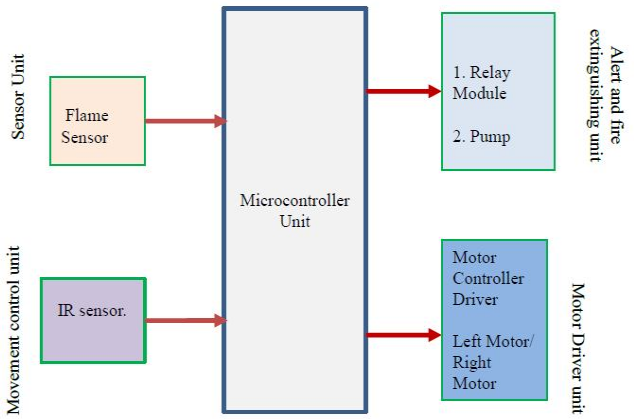

Fig 1: Block diagram

In this section block diagram of the project and design aspect of modules are considered. Block diagram shown in figure 1.

- The Fire sensors in the Robot sense if any fire and initiate signal to the Microcontroller.
- The Microcontroller by receiving the signal from the Fire sensor guides the robot to move towards the fire prone area.
- During the path if any obstacles arises, the IR sensor sense the obstacles and give the signals to the Microcontroller.

- The Microcontroller by receiving the signals from the IR sensor guides the robot to deviate the obstacles and move towards the fire prone area and lit off the fire.

The robot works with the instruction of embedded artificial intelligent in the microcontroller. In this study two IR pairs (infrared sensors) are used for avoiding the obstacle on the path of movement of robot. When the infrared sensor detect any obstacle then artificial intelligent will decide the direction of robot movement. 2-infrared sensors on the bottom for detect obstacle, when the sensors detected obstacle, output of comparator, LM324 is low logic and the other the output is high. Microcontroller and motor driver were used to control direction and speed of motor.

The robot moves forward autonomously towards the fire. During the movement of robot towards the fire if any obstacles on arise the 2-IR pairs placed in the bumper of robot to detect obstacles. There by IR sensors sends signal to the microcontroller about the presence of obstacle on the path. If it detects the obstacle then the embedded artificial intelligence starts working and the robot works autonomously.

After switching on the robot go into autonomously towards the menace area. All the IR pairs start continuously checking for obstacle. When IR1 only detect obstacle the robot turns right, for IR2 turns left. But some complicated situation (like IR1, IR2 detect any obstacle) the robot start perceiving. 1st it turns left for a certain time and check for getting other situation if get then flow the instruction, otherwise it turns right until getting situation chance. If any IR pair does not get any obstacle it moves towards forward.

III. HARDWARE IMPLEMENTATION

A. PIC MICROCONTROLLER

The PIC microcontroller was used as it's a RISC (Reduced Instruction Set Computer) processor which is better suited for real-time operations. Thus the midrange devices were chosen. The part 16F877 was used as it has 2 CCP modules which could be used in PWM mode thus simplifying the software routines to generate the PWM control for the motors.

The PIC microcontrollers are a group of 8 – bit microcontrollers of RISC architecture. It has various features few of which are given below. Microcontroller Core Features: • Only 35 single word instructions to learn • All single cycle instructions except for program branches which are two cycle • Operating speed: DC - 20 MHz clock input • 4K x 14 words of FLASH Program Memory, • Up to 192 x 8 bytes of Data Memory (RAM)

B. CRYSTAL OSCILLATOR

Figure shows the Crystal oscillator the clock frequency is provided by one 4 MHz crystal which is connected across the OSC1 & OSC2 pins as shown below. This provides an instruction execution time of 1 μ s.

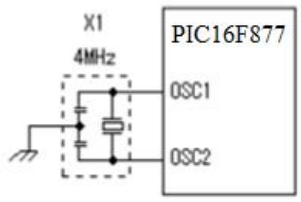

Fig 2: Crystal Oscillator

C. BATTERY

Motors on a robot consume most of the power. For most of them, each DC motor typically consumes 1.5W on the average. For differential steering, two DC motors consume up to 3W. By comparison, the logic components typically draw a total of about 80mA. Even at a supply voltage of 12V, the logic component only consumes 1W.
If we assume the whole robot consume 5W, it requires 4500J of energy to last 15 minutes. If we use a 12V battery, it must have a capacity of 4500J/12V=375Asec or 104mAH. This may imply that getting a battery of 150mAH is sufficient. Unfortunately, the discharge curve of a 150mAH will not sustain the required voltage for 15 minutes.
Thus a Lead Acid battery was used of rating of 1.2AH for the robot to last longer than 15min and also to take practical situations into considerations.

D. VOLTAGE REGULATOR

It has been shown that practically all electronic devices need DC supply. A direct voltage of constant magnitude requires to be supplied, for the smooth and efficient functioning of these devices. A properly designed voltage regulator ensures that, irrespective of change in supply voltage, load impedance or temperature, the DC supply is maintained at a constant level. This is achieved by incorporating some type of feedback in the regulator circuit.

An IC voltage regulator unit contains all the circuitry required in a single IC. Thus there are no discrete components and the circuitry needed for the reference source, the comparator and control elements are fabricated on a single chip. Even the over load and short-circuit protection mechanism is integrated into the IC.IC voltage regulators are designed to provide either a fixed positive or negative voltage, or an adjustable voltage which can be set for any value ranging between two voltage levels.

E. D.C. MOTORS

Electric motor is employed as a part of all the mechanical hardware. Electric motors are a strategy for changing over vitality. Motor take electrical imperativeness and gives mechanical essentialness as output. Electric motors are used to control numerous devices used in general life. Motors come in different sizes. A couple instances of broad motor applications join lifts, electric gets ready, cranes, and overpowering metal moving manufacturing plants.

Delineations of little motor applications consolidate motors used as a piece of cars, guides, hand power gadgets and sustenance blenders. Small scale machines are electric machines discover various applications in therapeutic, for example, with parts the range of red platelets.

F. IR SENSOR

Infrared Proximity Sensor: Infrared has a wavelength longer than noticeable light yet shorter than the microwave. It is an electronic contraption that emanates and/or faculties some a player in its environment. The extent of infrared join 710 nm to 100 mm. According to black body radiation relying upon their temperature all the items discharges radiations. Wavelength radiated by the hot body is shorter when contrasted with cool. The Earth emanates infrared light of around nine to 10 small scale meters, along these lines do warm-blooded animals like individuals. This light can be used to recognize development of warmth. Driven IR Detectors utilized as a part of our undertaking perceive infrared light. The light-transmitting diodes (LEDs) as a property that it conveys a light when it is empowered by electric current moreover they release current by application light of same wavelength.

G. IR FLAME SENSOR

The flame sensor is very sensitive to IR wavelength at 760 nm ~ 1100 nm light.
Analog output (A0): Real-time output voltage signal on the thermal resistance.
Digital output (D0): When the flame temperature reaches a certain threshold, the output high and low signal threshold adjustable via potentiometer.
Pins:
VCC..... Positive voltage input: 5v for analog 3.3v for Digital.
A0..... Analog output
D0..... Digital output
GND..... Ground

H. LCD display

A Liquid crystal display (LCD) is a less expensive, small power device proficient of showing texts. LCDs are really collective in embedded systems; subsequently such systems frequently do not have audio-visual screens like those that come typical with desktop structures. LCDs can be found in various common devices like watches, fax and copy machines, and calculators.
The LCD controller provides a moderately simple interface among a processor and an LCD. LCDs can be added quite effortlessly to a solicitation and use as 3 digital output pins for control

I. Relay

A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

IV. SOFTWARE IMPLEMENTATION

A. EMBEDDED C

An embedded system is an application that contains at least one programmable computer typically in the form of a microcontroller, a microprocessor or digital signal processor chip and which is used by individuals who are, in the main, unaware that the system is computer-based. This type of embedded system is all around us. Use of embedded processors in passenger cars, mobile phones, medical equipment, aerospace systems and defense systems is widespread, and even everyday domestic appliances such as dishwashers, televisions, washing machines and video recorders now include at least one such device.

Embedded systems have turned out to be hugely starting late, in their noticeable quality and also in their multifaceted nature. Gadgets are logically getting the opportunity to be astute and self-decision. Coolers, ventilation frameworks, cars, cell phones etc., are a segment of the ordinary instance of contraptions with understood information. These gadgets capacity in view of working and ecological parameters.

The insight of brilliant gadgets dwells in installed frameworks. An installed framework, with everything taken into account, in cooperates gear, working framework, low-level programming limiting the working framework and periphery devices, and correspondence programming to engage the device to perform the pre-described limits. An Embedded frameworks performs a lone, particularly described task, is immovably constrained, is responsive and registers comes about constantly.

B. FLOWCHART

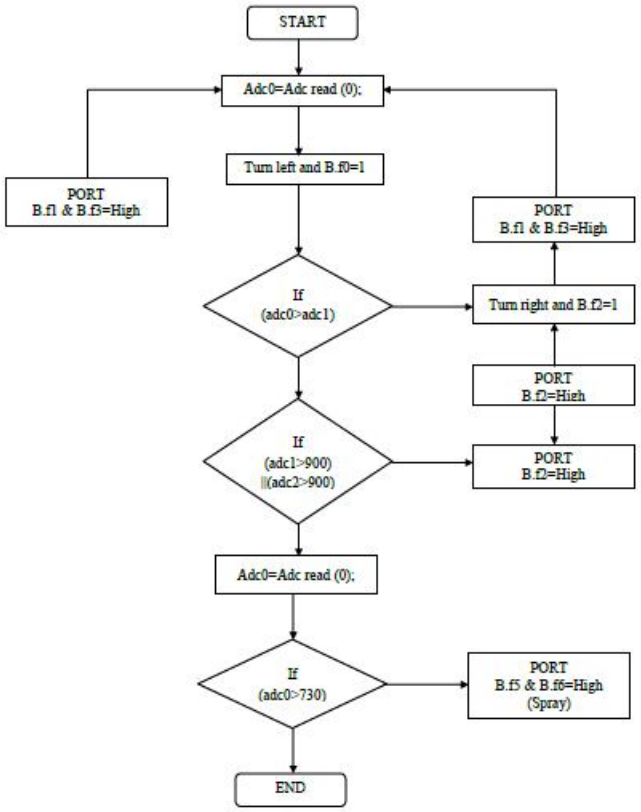

Fig 3: Flowchart of the process

V. RESULT AND DISCUSSION

The developed robot has been tested to evaluate performance analysis as well as to demonstrate the ability to move autonomously by avoiding obstacles. The robot avoids both the static obstacles and dynamic obstacles during its movement. The robot has shown quite good performance to detect the obstacles and move in new path. Finally the robot moves towards the fire prone area and extinguish the fire using water discharge unit.

The robot detects the obstacle with the aid IR sensor used, if the obstacle is present on the left side then the robot moves reverse by a small distance and it takes the tilt towards the right. In the same way if the obstacle comes in right side, and then it takes a deviation towards the left. If both sensor senses the obstacles then the robot moves reverse by long distance as compared to previous cases and it tilts either to its right or left again by sensing any obstacles in its new path.

The above movements of the robot are efficiently achieved by the usage of artificial intelligence in the robot that is with proper programming of the microcontroller. Here the robot is effectively programmed by using Embedded C to get the above said results.

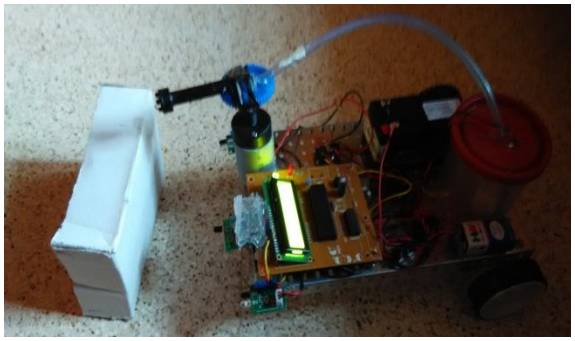

Fig 4: Autonomous robot detecting the obstacle

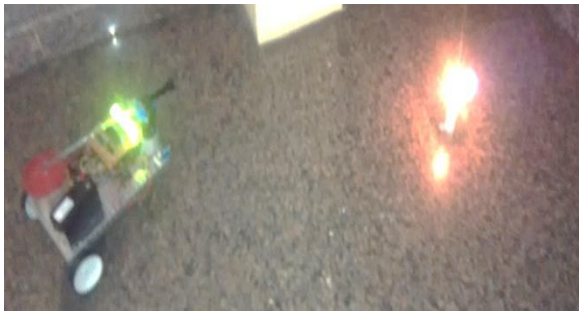

Fig 5: Autonomous robot detecting the fire and moving towards the fire.

VI. CONCLUSION

The developed autonomous robot efficiently avoids obstacles during the movement. Therefore the autonomous robot can be efficiently used in manufacturing facilities in situations like to stop the fire / other accidents not only in industries and in domestic areas also. The autonomous robot may also be used in the cases of gas leakage detection with the aid gas leakage detecting sensors in chemical and oil industries if any accidents occur with the suitable modification in the programming part.

Autonomous robot for menace area is just not an idea now; rather it is demand in this era of automation engineering. An autonomous robot can work for extinguishing fire simultaneously with the human without requiring any kind of command and also can work individually where there is life risk of a human. Even a robot can be more efficient and quick than human. Besides it takes some time to inform fire service team and then their arrival to the spot. But if there is an autonomous fire extinguisher robot in every factory or shop or house, the loss of life and assets can be reduced significantly as the robot will go for action as soon as it detects any kind of symbol of fire.

It can be concluded that our endeavor can be valuable in application, not for only menace areas it can also be employed many distinguished areas for example, transportation assessment undertakings industry and Agriculture security and observation where in human intercession can be risky and can be maintained a strategic distance from like mining, toxic gas environment and so on.

VII. FUTURE SCOPE

- More features can be added or can be replaced with the requirement of the task.
- Its embedded artificial intelligence can be improved with the requirement of the task.
- Incorporate extra sensors like temperature sensor, gas leakage detection sensor, smoke sensor and increasing the number of flame sensor so as to effectively detect the menace areas.
- For obstacle detecting Ultrasonic sensors can be employed for more accuracy.

REFERENCES

[1] Ritika Pahuja, Narender Kumar, "Android Mobile Phone Controlled Bluetooth Robot Using 8051 Microcontroller" IJSER, Volume 2 Issue 7, July 2014

[2] K.Chandrakanth, M. Yaswanth Kumar, Ch. Mahesh, Dr.B.S.RAO, "Advanced Integrated Fire Halt Robot", International Journal on Recent and Innovation Trends in Computing and Communication" Volume: 4 Issue: 5, PP 201 – 203, 2016.

[3] Najia Manjur, Minhajul Arifin, Rehennuma Islam, Fariha Nusrat, Rubyeat Islam, Rownak Tabassum, Nazmul Hasan, Wali Mohammad Abdullah and Md. Afzal Hossain ," Light Following & Obstacle Avoiding Robot using Autonomous & Android Based Manual Controller", IEEE, Volume 15,2015

[4] A. Dhumatkar, S. Bhiogade, S. Rajpal, D. Renge and P. Kale, "Automatic Fire Fighting Robot", International Journal of Recent Research in Mathematics Computer Science and Information Technology, vol. 2, no. 1, pp. 42-46, 2015.

[5] Thai Nguyen, Hai Xuan Le "Path planning and Obstacle avoidance approaches for Mobile robot" International Journal of Computer Science Issues, Volume 13, Issue 4, July 2016

[6] Dheepak Mohanraj,"Microcontroller based an autonomous wireless line tracking robot" Int. J. Adv. Engg. Res. Studies, III/April-June, 2016

[7] M.Bala Subramanian, Dr.K.Sudhagar, G.RajaRajeswari,"Optimal Path Forecasting of an Autonomous Mobile Robot Agent Using Breadth First Search Algorithm", International Journal of Mechanical & Mechatronics Engineering, Vol 14, April 2014

[8] Anup Saha, Amit Saha, MD.Abdur Rahim, Pallab Sutradhar," Mobile Phone Controlled Autonomous Robot", International Journal of Scientific & Engineering Research, Volume 4, Issue 9, 2013.