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COMPUTER SCIENCE

**Keyword's:** Robot, drivers, LED, Microcontroller, Image processing

# SELF HEALTH REGULATION OF AUTONOMOUS ROBOT


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**ABSTRACT**

This paper aims at Health Regulations of an autonomous robot. As robot is autonomous, it has to find out its energy requirement that is stored in the batteries. It has to self charge to the required level whenever charge left inside the battery is low. Robot has to find out the temperature of the motor drivers and if temperature of the motor driver is above the predetermined value fan should be turned on to cool the motor driver. If intensity of the surrounding light is below the threshold value then LEDs(Light Emitting Diodes) should be turned on. Atmega32 microcontroller is used to control the hardware. AVR studio software is used to write the embedded C Program and Lab view is used for image processing.

## I. INTRODUCTION

Autonomous robots can perform desired tasks in unstructured environments without continuous human guidance. Many kinds of robots have some degree of autonomy. Different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, cleaning floors, mowing lawns, and waste water treatment

Embedded systems have several common characteristics that distinguish them from other computing systems: Single Function, Tightly Constrained, and Reactive to Real Time.

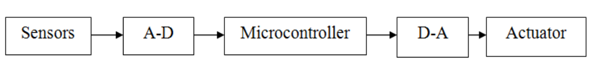



Figure 1.1 Simple Embedded System Structure

Computer vision is concerned with the theory and technology for building artificial systems that obtain information from images. Sub-domains of computer vision include scene reconstruction, event detection, tracking, object recognition, learning, indexing, ego-motion and image restoration.

This paper mainly focuses on

- To design and develop the Mechanical structure of a Robot.
- To design the interface for communication between the laptop and the Controller.
- To design the power supply interface for Controller and Actuator.
- To develop the software in Embedded C for AtMega32 microcontroller.
- To develop the software in LabVIEW for Image Processing.
- To test the working functionality of the developed Self Health Monitoring of Robot.

A key driving force in the development of mobile robotic systems is their potential for reducing the need for human presence in dangerous applications, such as the cleanup of toxic waste, nuclear power plantdecommissioning, extra planetary exploration, search and rescue missions and security, surveillance, or reconnaissance tasks, or in repetitive types of tasks, such as automated manufacturing or industrial household maintenance.

## II. SYSTEM DESIGN

The overall system mainly consists of Camera, laptop, Microcontroller, Sensors, DC MotorsTwo 12V Lead-Acid Batteries.

Camera: USB Camera of resolution 320*240 is used to capture the images. Captured images are stored in laptop via USB connector. These captured images are compared with the pre-stored images of charger to identify the charger location.

Laptop: It is used to identify the charger present in the captured image using image processing technique. For this process LabVIEW software is installed in the laptop. After identifying the charger, the information is given to the microcontroller. Laptop is connected to the controller via RS232 communication.

Microcontroller: AtMega32 Microcontroller is interfaced with sensors, actuators and laptop. First Sensors: Four type of sensors are used in this project. LM35 as temperature sensor to measure the temperature of motor driver. Potentiometer is used to measure the output voltage of the battery. Light Dependent Resistor(LDR) is used to measure the intensity of surrounding light and IR sensors for obstacle avoidance. microcontroller identifies the charge left inside the battery using sensors value and if the sensed value is below threshold then it sends signal to laptop to identify the charger. Once charger is located, this information is given back to the microcontroller. Based upon this information microcontroller sends signals to actuators to move the Robot to the charging location.

DC Motors: Two Geared DC Motors are used for the purpose of Robot movement and One motor is used for camera movement. Motors are connected to microcontroller via L298 motor driver.

Batteries: Two Lead-Acid Batteries are used in this project. One battery is used to run DC motors and another battery is used for other hardware circuitry.

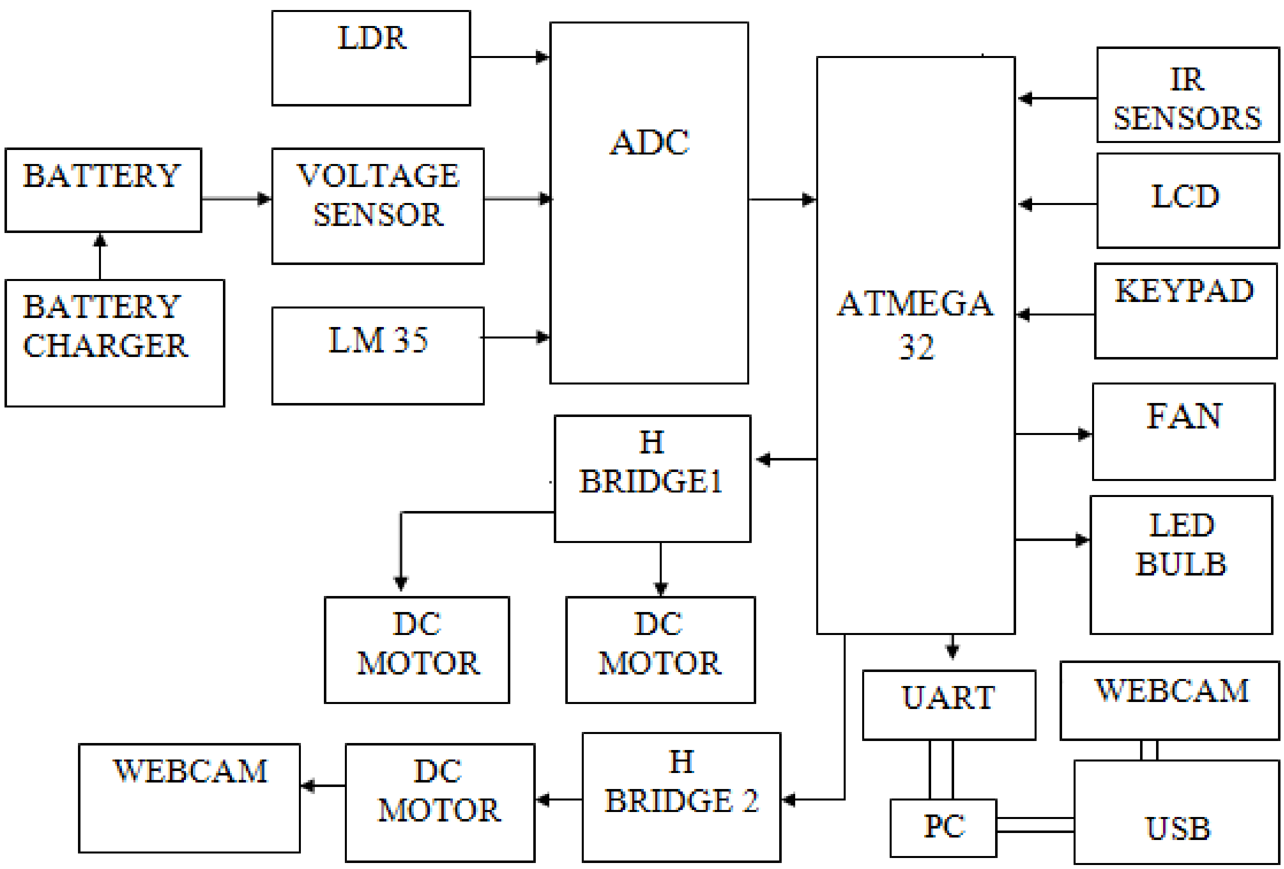



**Figure2.1** System Block Diagram

## III. HARDWARE DESIGN

Six sensors are used in this design.Two IR Sensors are connected to PORTB of the microcontroller. These sensors are used as obstacle detection and assist in Robot movement. Four sensors are conneced to Port A of the AtMega32 microntroller. One Thermistor is used to measure the temprature of the motor driver. Two Potentiometers are used as voltage sensors to measure the Charge left inside the battery. One Light Dependent Resistor(LDR) is used as light sensor to measure the intensity of the surrounding light. Analog output from these four sensors are converted into digital form to measure the various parameters and are usd to control the action of the Robot. To use PortA as ADC, AVCC and AREF pins of micronroller are made high. Microntroller uses successive approximation method to convert analog value into digital data. Motors are connected to microntroller via L298 motor driver. In this project two L298 drivers are connected to Port C of the microcontroller. Each driver can control two motors. Three motors are used in this project. Two motors are used to control the movement of the robot and one motor is used for camara motion. Fan and LEDs are connected to the pinD7 and PORTD6 of port D. If temperature of the motor driver is above the predetermined value fan will be turned on to cool the motor driver. If inensity of the surrounding light is below the threshold then LEDs will be turned on. Pins D0 and D1 of port D are used for UART communication between microntroller and PC. Camara of resolution 320*240 is used for vision based robt navigation. LabVIEW

software is used for capturing and identifying the charger location. Embedded C langauge is used in AtMega32 microcontroller to control and coordinate all Robot functions. PC is connected to micronroller via MAX232 driver. The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Liquid Crystal Display is connected to PORTA and PORTC of the microcontroller and is used to display the project information and values of sensors. Keypad consisting of four keys is connected to PORTB of the microcontroller and is used to run the robot in autonomous and semi-autonomous mode.

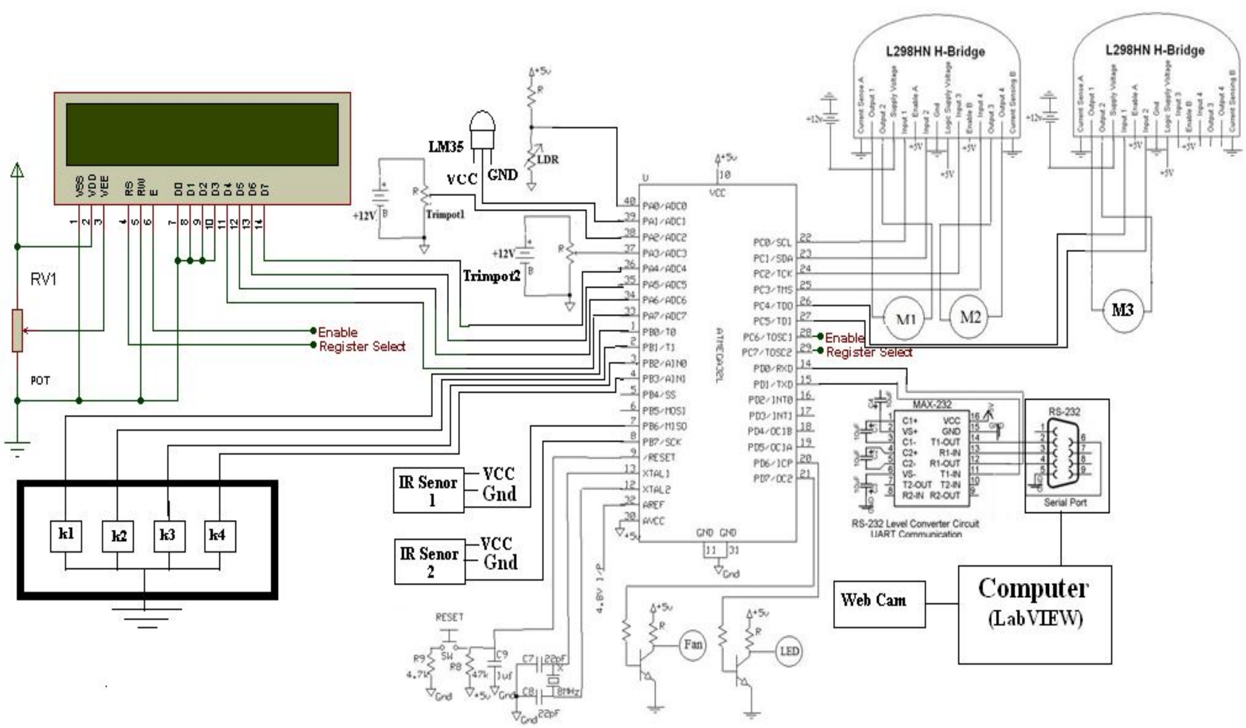


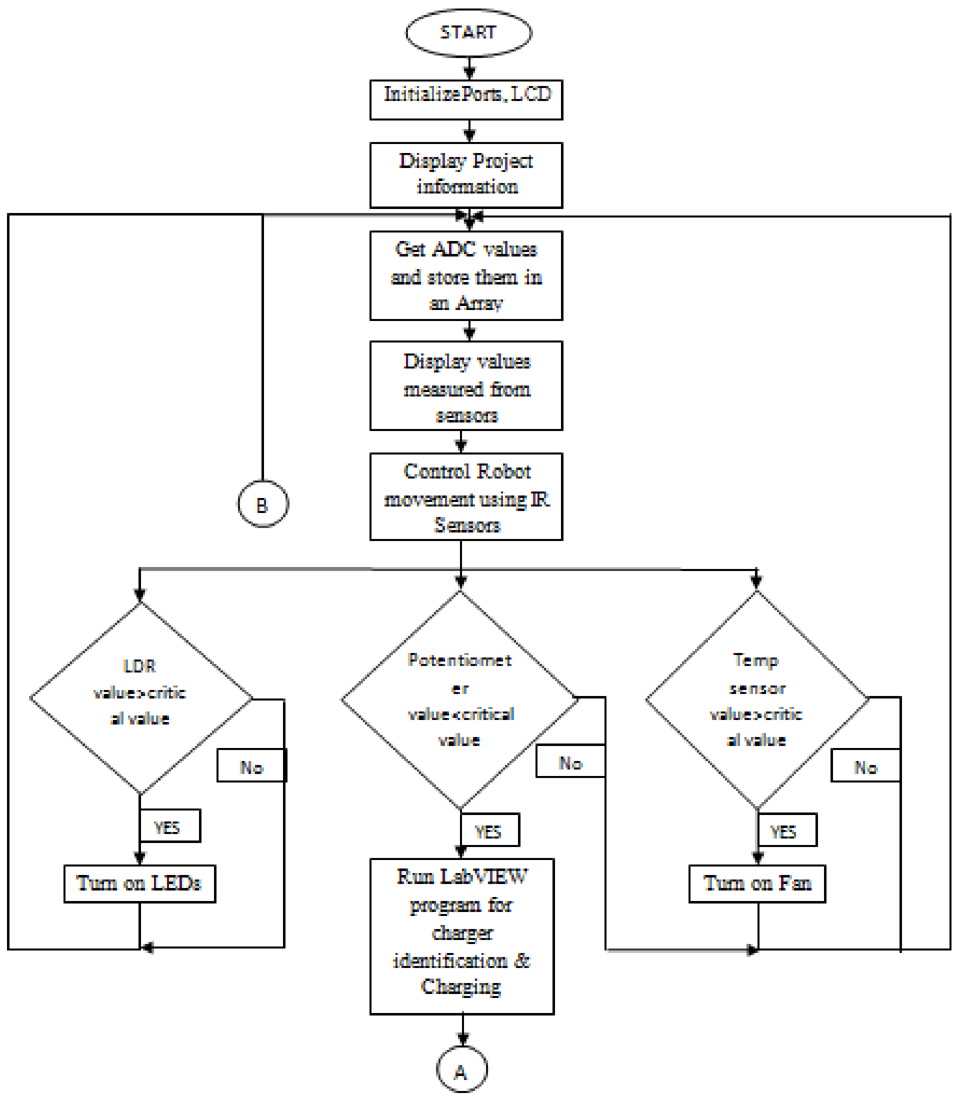

**Figure3.1** Circuit Design

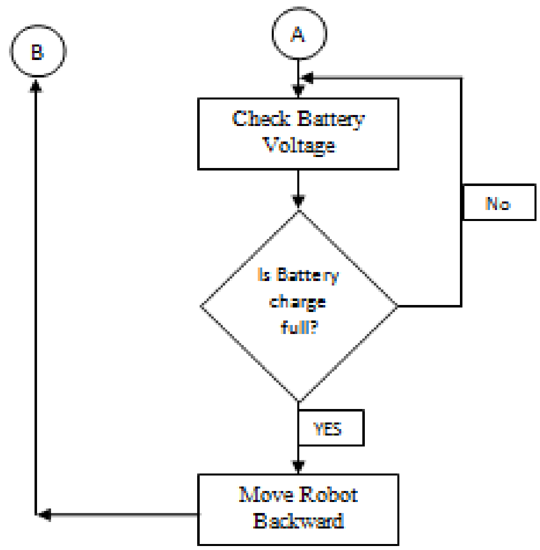
## IV. SOFTWARE DESIGN

To implement this design software is written using two languages. First language is 'Embedded C' written using AVR Studio software which runs under AtMega32 microcontroller.

Second language is 'G' language written using LabVIEW software which runs under laptop. LabVIEW is integrated fully for communication with hardware such as RS-232, RS-485, and Plug-in data acquisition boards. LabVIEW contains comprehensive libraries for data collection, analysis, presentation, and storage. Communication between microcontroller and laptop is done using UART.

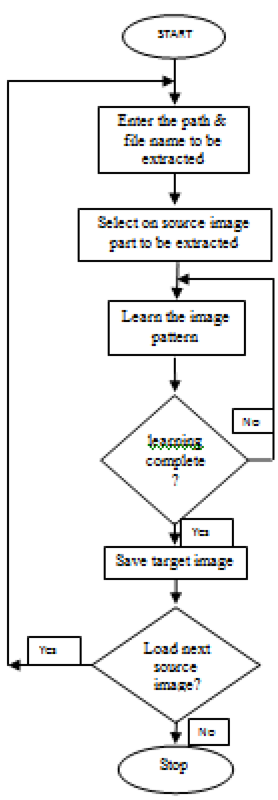
### A. Flow chart for program written using Embedded C



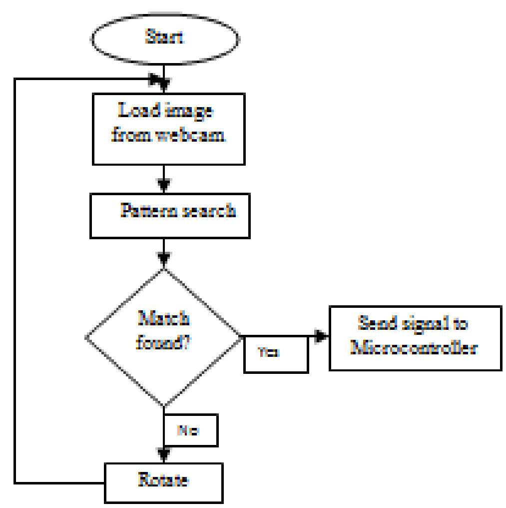



B. **Flowchart for program written using G language in LabVIEW**

**Database creation**




**Charger Identification**



## V. RESULTS

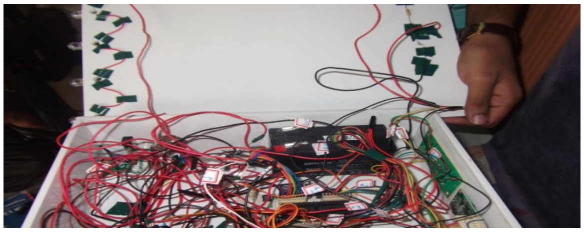


**Fig 5.1** Integrating the hardware components

In Figure 5.1, Board contains ATMega32, which controls all the hardware component like LCD,LEDs, H-Bridges, DC motors, Keypad, Sensors, Battery and their connection.

**Figure 5.2** Health Monitoring Robot

Figure 5.2 shows autonomous robot which can monitor its health without human intervention. Camera is connected to laptop via Universal Serial Bus and Laptop is connected to AtMega32 microcontroller using RS232 communication. The aim is successfully achieved by designing the robot with camera as its eye and its wheels for movement. The robot is moved from one location to the other location on recognizing each object encountered in the path. Robot recognizes the charger successfully and move towards the charger for self charging.

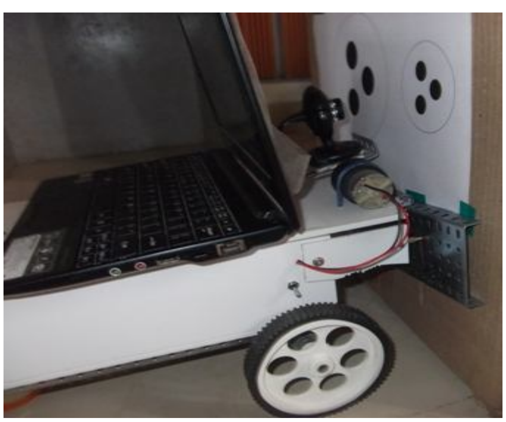


**Figure 6.1** Successful charging of robot

Table 5.1 gives the list of various sensors used and their functions

**Table 5.1** Sensors and their functions

| Sensors | Function |
|---|---|
| LM-35 Temperature sensor | When Temperature exceeds 30°C fan turns on and turns off below 27°C |
| Light Dependent Resistor | To control the operation of LEDs. Turns on when light intensity is below 10Lux and turns off when light intensity is greater than 10 lux |
| IR Sensors | For Navigation. Two IR sensors used at left and right in the front end. Left sensor turns the Robot to the right and right sensor turns the Robot to the left |
| Trim Pot | Senses the voltage level of the batteries |
| Camera | Charger identification |

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