ISSN (Online): 2456-0448
International Journal of Innovative Research in Management, Engineering and Technology
Vol. 3, Issue 3, March 2018

Patient Serving Robot

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Abstract: ***This paper describes the techniques for analysing, designing, controlling and improving the health care management system. It deals with automation which plays key role in medical field. Robots are considered as substitute for human beings during their absence or to reduce human's work load. Automation is observed in many industries for lifting and carrying goods. But it is very rare to be seen in hospitals. Design and development of a system to carry medicine or food to the patient's room by a patient serving robot is proposed. The obstacle in the path is detected by proximity sensor which is mounted on the robotic vehicle. The robot identifies the respective patient room with the help of RFID tag and reader where the RFID tag is placed in every patient's room. The robotic arm is placed in the robotic vehicle which holds the object and delivers. The entire system is controlled using Arduino UNO ATMEGA328P which is cost efficient and also simple in construction. The main task of this kind of robots is to find their way inside the hospital to carry the stuff around. This technology is mainly focused on delivery of medicines to patients with appropriate time.***

Keywords: ***Infrared sensor; Microcontroller; DC motor; Motor driver; Alarm circuit; Servo motor; Voltage Converter; RFID tag; Robotic arm.***

I. INTRODUCTION

A health care system is defined as the organization of the people, resources and the institute to provide the health care services to the person. The goal of health care management system is to provide good health to public. For maintaining the health in a better way, institutes, charities, religious and government organizations are planning around the world. The health care system also includes the hospitals, medical colleges health care institution or clinics either these are operated by government, private for profit organization and also private not for profit organizations. All around the world, many patients suffer because of the cost of the health care system. The fee for the medical practitioners depends on the service, medicine, capitation and the salary of the personnel. For continuous monitoring of the patients, health care system needs many personnel. This increases the cost of the healthcare management system. It is very difficult for continuous monitoring of the patients. Proposed patient serving robot based health care management system can be very effective in continuous monitoring of the patients, whenever they need any help or medicine. That robot based health care management system can reduce the cost involved with increased perfection in the service delivered. Figure 1 represents the patient serving robot in health care providing facility.

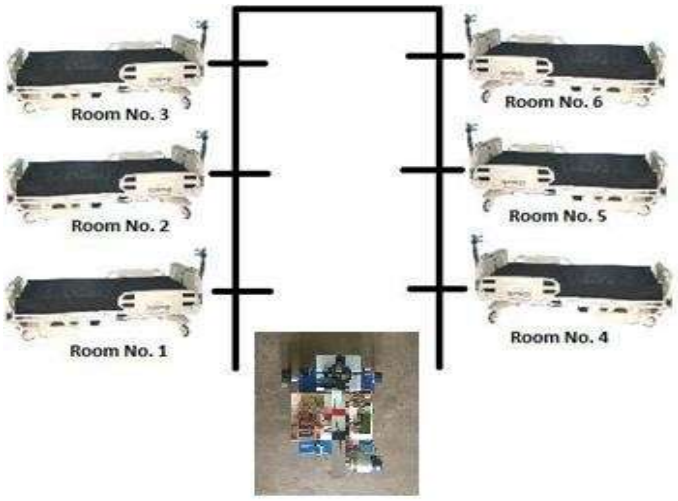


Figure 1. Patient serving robot with health care rooms.

II. MOTIVATION

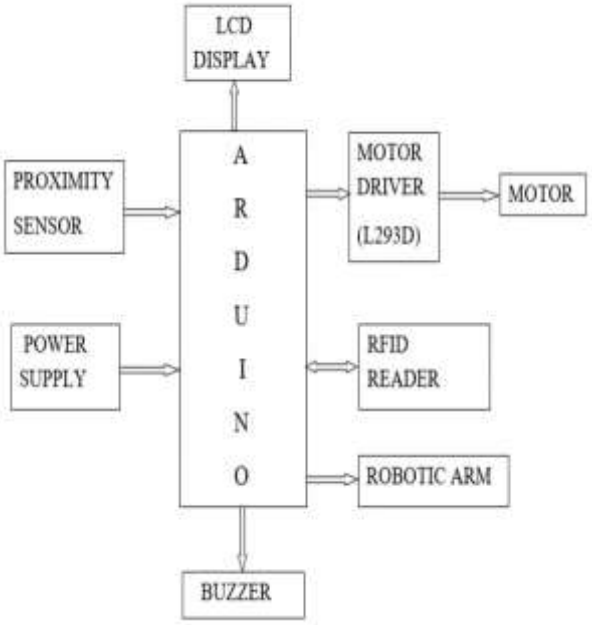
Now a days, proper health care management is lagging around the world. The patient's situation and mortality rate are getting worse due to lack of service and delay in attention provided. Research shows that a number of patients died because very few trained medical staff are available. Shortage of nurses is 'killing thousands a year. Patients in overstretched hospitals develop fatal complications which could have been cured and avoided [8]. A lot of hospitals have stopped recruiting nurses and medical personnel since 2015 and 2016. Since the past two years there is an increasing trend of recruiting more doctors than the nurses. If sufficient number of nurses are recruited then the number of deaths can be estimated to decrease by
10%. The critical patients in a hospital and health care environment need continuous monitoring with the help of sophisticated equipment which only trained and skilled nurses can operate efficiently and effectively [3]. So the medical personnel are of paramount importance to deliver a quality health care to patients. The detection and alert system proposed will help solve this problem.

III. RELATED WORK

In robotics there are many systems invented which have different applications in different fields. Robotics is very popular field for research and manufacturing. A line follower and the obstacle avoidance bot was developed by Aamir attar. et.al, which has the IR sensor to trace a particular line and ultrasonic sensors to detect the obstacles the bot encounters [1]. An Autonomous Serving Robot was developed by Neetimalik. et.al, which will take order and serve the food to the customer [2]. A Pick and Place Robot was developed by Dheepak Mohanraj, which focuses on the usage of PIC as a controller, motor as a mover and sensor as the line guider [3]. A line following robot was developed by Deepak Punetha. et.al, which has the IR sensor to detects the obstacle [4]. A line follower robot was developed by SavitaPatil. et.al, which has the ability to choose a desired line among multiple colored lines [5]. Arnavkumar. et.al, proposed a new mobile robot architecture and investigates the motion control subsystem of that architecture [6]. A line following robot was developed by Thirumurugan.J. et.al, which is used for library inventory management system (LIMS) [7]. A line follower robots built using microcontrollers was developed by Ebiesuwa O. et.al, which has sophisticated color sensors to enable the robot to be able to detect its path in the shortest possible time which is in the order of nanoseconds [8]. Prananjali Koppad. et.al, says that a robot is a machine design to execute one or more tasks repeatedly with speed and precision [9]. Kanwaljeet Singh. et.al, says that the Line follower robot is a mobile machine that can detect and follow the line drawn on the floor [10].

IV. SYSTEM OVERVIEW

When the robot moves in a hospital environment to deliver food and medicines, it may face some obstacles like walls, human beings and some other objects. It is necessary to help the robot to overcome the obstacles. Hence, the obstacles are detected with the help of proximity sensor. The transmitter in the IR proximity sensor radiates infrared rays. The changes in the reflected signal indicates that there is an obstacle. This proximity sensor is fixed in the robot. Thus, the robot can encounter the obstacle in all directions and it can change its path witth the program which is dumped internally in the Arduino UNO. The data from the sensor will be given to the Arduino and it gives corresponding signals to the motor driver IC. L293D motor driver IC is used in this project to drive the motor of the robot. It receives
Figure 2 Block diagram of patient serving robot



signal from Arduino based on the information from the IR sensor. Figure 2 represents the block diagram of patient serving robot. It has two DC motors at the rear of the patient serving robot. These motors provide more torque than normal motor and can be used for carrying some load as well.

The EM18 is an RFID reader which is placed in the robotic vehicle. The RFID tag is fixed in every patient's room for identification. The process follows the scanning of RFID tag. Then the robot will enter the corresponding patient's room for the delivery of medicines. After reaching its destination, the robot serves the patient with prescribed medicines and it also provides food in exact time.

A. Arduino UNO

Figure 3 represents the pin diagram of arduino UNO. Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit boardand ide that runs on your computer, used to write and upload computer code to the physical board. The Arduino ide uses a simplified version of c++, making it easier to learn to program

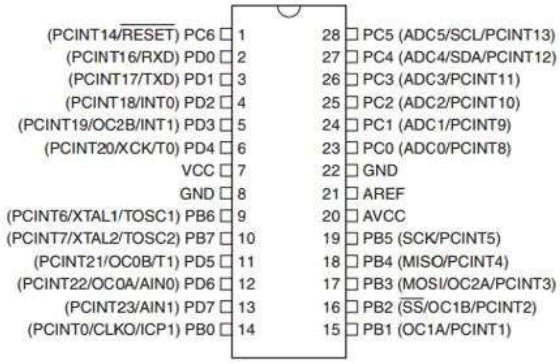


Figure 3. Pin diagram of Arduino UNO

ISSN (Online): 2456-0448
International Journal Of Innovative Research In Management, Engineering And Technology
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B. Sensors

Figure 4 represents the IR transmitter and receiver circuit. Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. It is to be noted that both IR transmitter and receiver are placed in a straight line. The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED passes the IR rays to the receiver. The IR receiver is connected with comparator. The comparator is constructed with LM 358 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal.
The non-inverting input terminal is connected to IR receiver. This circuit is mainly used to for counting application, intruder detector etc.

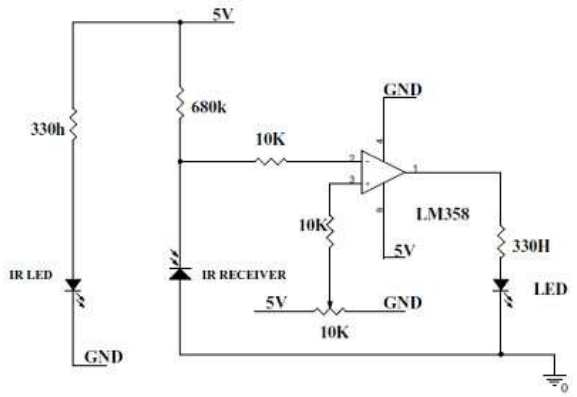

Figure 4. IR transmitter and receiver circuit

C. Battery

A battery is a device in which chemical energy is directly converted to electrical energy. It consists of one or more voltaic cells, each of which is composed of two half cells connected in series by the conductive electrolyte.

Figure 5 represents the power supply circuit. Each cell has a positive terminal, shown by a long horizontal line, and a negative terminal, shown by the shorter horizontal line. These do not touch each other but are immersed in a solid or liquid electrolyte. The electrolyte is a conductor which connects the half-cells together. It also contains ions which can react with chemicals of the electrodes.
Chemical energy is converted into electrical energy by chemical reactions that transfer charge between the electrode and the electrolyte at their interface. Such reactions are called *faradaic*, and are responsible for current flow through the cell. Ordinary, non-charge- transferring (*non-faradaic*) reactions also occur at the electrode-electrolyte interfaces. Non-faradaic reactions are one reason that voltaic cells (particularly the lead-acid cell of ordinary car batteries) "run down" when sitting unused.

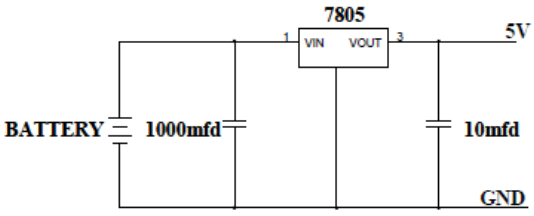

Figure 5. Power supply circuit

D. Motor Driver

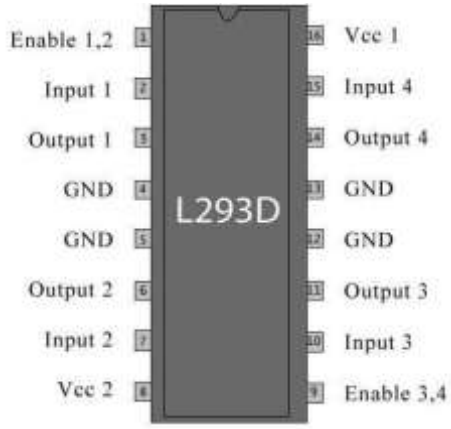

Figure 6. Motor Driver IC L293D

Figure 6 represents the pin diagram of motor driver IC L293D. Motor driver acts like the current amplifier. It is used for controlling the current in the motor. The motor driver provides high current the dc motor needs when it receives low current in the circuit. For drive the motors a high value of the current is needed.

L293D IC can control the two dc motors simultaneously. It can rotate the motor in the forward and reverse directions. By using the motor driver a line following robot can move in clockwise and in anticlockwise directions.

In a single L293D chip there are two h-Bridge circuits inside the IC which can rotate two dc motors independently. Due its size it is very much used in robotic applications for controlling DC motors. There are two Enable pins on l293d, Pin 1 and pin 9. To drive the motor, the pins 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1. And for right H-Bridge pin 9 to be made high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.

There are 4 input pins for l293d, pin 2, 7 on the left and pin 15, 10 on the right. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. The maximum voltage for VSS motor supply is 36V. It can supply a max current of 600mA per channel. VCC pin

16 is the voltage for its own internal operation. The maximum voltage ranges from 5v and upto 36v.

transistor switches OFF, due to that collector and emitter terminal are open circuited. Q6 transistor is connected with the Q5 transistor collector terminal. When Q5 is ON at that time Q6 will OFF. The servo motor speed will be varied depending upon the ON- OFF pulses. Figure 7 represents the regulator circuit. Figure 8 represents the switching circuit.

Figure 7. Regulator circuit

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E. Actuators (Motors and wheels)

For the proper movement of the system two dc motors are used in the circuit and a castor wheel is attached in

Figure 8. Switching circuit

F. Buzzzer

the front side of the patient serving robot. Caster wheel enable easy movement of the robot in every direction. Two dc motors at the end side of the robot is controlled by the motor driver. For controlling the complete system a microcontroller is used, which sets its flag bit as per the different situations. And this complete system needs a small power supply of 9 V, which can be provided from a battery.

Regulator circuit: Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of a fixed positive voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from the third terminal, with the second terminal connected to ground.

Switching circuit: Then the PWM high pulse is given to the base of the BC557 switching transistor. Now the A buzzer or beeper is a signalling device, usually

electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if any button is pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which is identical to an electric bell without the metal gong (which makes the ringing noise).

Often these units are anchored to a wall or ceiling and used the ceiling or wall as a sounding

board. Another implementation with some AC- connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm

speaker. Nowadays, it is more popular to use a

ceramic-based piezoelectric sounder like a Sonalert which makes a high-pitched tone. Usually these are hooked up to "driver" circuits which varies the pitch of the sound or pulses the sound on and off.

G. Alarm circuit

Figure 9 represents the alarm circuit. The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the pair of switching transistors (BC 547). The buzzer is connected in the Q2 transistor collector terminal.

When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and close the collector and emitter terminal so zero signals is given to base of the Q2 transistor. Hence Q2 transistor and buzzer is turned OFF state.

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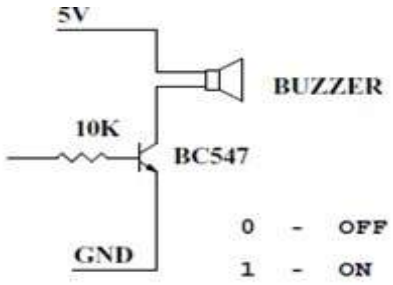

Figure 9. Alarm circuit

When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF. Now 12v is given to base of Q2 transistor so the transistor is conducting and buzzer is energized and produces the sound signal. Table 1 represents the working of transistor.

Voltage Signal from Microcontroller or PC	Transistor Q1	Transistor Q2	Buzzer
1	on	off	off
0	off	on	on

Table 1. Working of Transistor

H. Liquid Crystal Display

Figure 10 represents the pin diagram of liquid crystal display. A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel in LCD consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters,
with the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

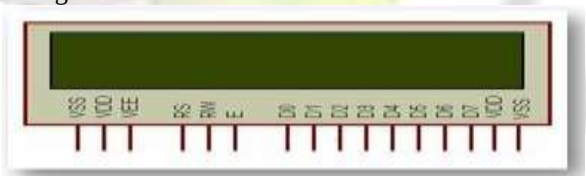

Figure 10. Pin diagram of liquid crystal display

I. RFID Reader

Figure 11 represents the pin diagram of RFID reader. The em-18 RFID reader module operating at 125 KHz is an inexpensive solution for your RFID based application. The reader module comes with an on-chip antenna and can be powered up with a 5v power supply. Power-up the module and connect the transmit pin of the module to receive pin of the microcontroller. The card is shown within the reading distance and the card number is displayed at the output.

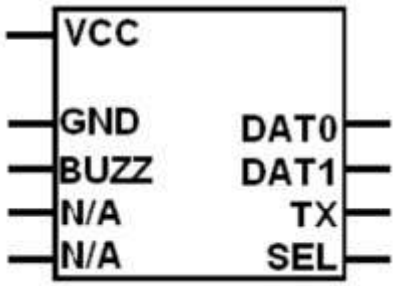

Figure 11. Pin diagram of RFID Reader

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V. RESULTS

Infrared based sensor is placed in the patient serving robotic vehicle which detect the presence of obstacle. With the help of this, the robot changes its direction and moves ahead to the destination. DC motor must be controlled by the motor driver for movement of the robot. For left movement the left side dc motor should be stop and the right side dc motor should be run in forward direction. The patient's room is identified with the help of RFID reader EM18 and tag. Medicine are carried to the patient room with the help of pick and place robotic arm. The arm works with the help of servo motor. It serves the medicines to the patient room. Figure 12 represents the snapshot of patient serving robot. Table 2 represents the direction of movement of patient serving robot.

Figure 12. Snapshot of Patient Serving Robot

ROBOT MOVEMENT	LEFT MOTOR	RIGHT MOTOR
Straight	Straight	Straight
Left	Stop	Straight
Right	Straight	Stop
Reverse	Reverse	Reverse

Table 2: Direction Movement of Robot

VI. FUTURE WORK

Patient Serving Robot based health care management system can play a vital role in the medical field. It reduces the cost of medical practitioners. It is beneficiary for the patients. The proposed robot automatically finds the patient's room and place the medicines with the help of RFID reader and tag. In the initial stage, medicines need to be placed in the robotic vehicle manually. And also random pickings of the medicine placed in the robot is difficult to identify properly. Up to now patient serving robots made ready to serve the patients in hospital without the help of human. Identifying the proper medicine is still a bit challenge.

CONCLUSION

In a populated country like India, Health care management is very difficult. To overcome the barriers, patient serving robot will be a handy vehicle for effective service. This Robot can be tested and demonstrated in real time environment places like Government and Private hospitals.

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