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Development of Robotic Arm to Assist Differently ABLED and Elderly People

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***Abstract*— Differently abled people who don't have legs or arms have to depend entirely upon others to perform simple tasks, also elderly people suffer a lot to accomplish tasks that are important to lead daily life. Hence they need an assisting device which helps them to lead comfortable life. Application of robotics has become crucial and vital in the field of medical electronics in the present era, this paper deals with design of a robot which can help differently abled people to perform simple tasks such as pick and place through micro switch controlled signals and gesture control. The robot is equipped with intelligent sensing which alerts the presence of fire and water.**

***Key Wards:*— Accelerometer, RF module, IR module, Degree of freedom, Micro Switches, Microcontroller, Thermistor.**

I. INTRODUCTION

A robotic arm is a robot manipulator, which can perform similar functions to a human arm. Robotics is the emerging area which is the vital part of almost all the industries such as aerospace, mechanical, automobile industries, medical sectors and many more. Fig.1 shows the schematic of the robotic arm.

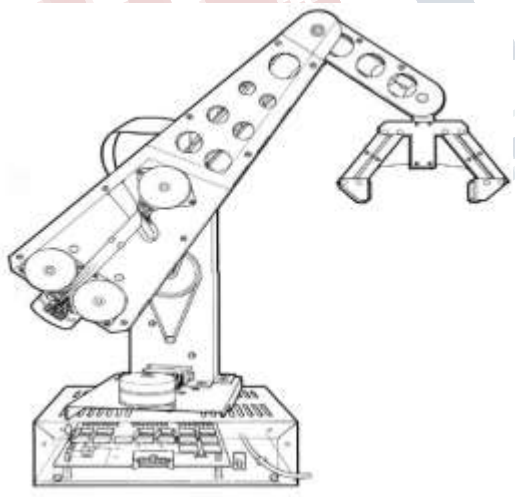

Fig.1: Schematic of Robotic Arm

The disability of an individual to perform the normal routine tasks is may be due to the loss of legs or hands because of meeting accidents, also few patients suffer from disability to move their hands or legs because of strokes [1]. Hence the physically disabled patients will have to depend upon others to accomplish even simple tasks. The main objective of the work is to improve the life quality of differently a bled people.

A wireless semi-automated robot is designed to meet the objective, which can assist differently abled people to accomplish simple tasks such as pick and place of objects, here the robotic base is designed to move in all four directions and also in desired angles, the wireless control of the robotic base is made using tilt sensor and Radio Frequency transmitter, also the robot is interfaced with micro switches which can be mounted on the neck or some proper functioning part of the body to control the robotic base, the robotic arm is enabled by the Infrared sensor in such a way that it can pick the object in front of it upon receiving IR radiations.

The robot is equipped with intelligent sensing, it provides indication regarding presence of fire and water using appropriate sensors and 89C51 microcontroller. Hence the robot will alert the physically disabled patients regarding the possible hazard (fire) and also guarantees its personal safety (against fire and water).

II. METHODOLOGY

In this work, a robot with three degrees of freedom [2] is designed, which is able to pick the desired object and place them at the desired location [3].

Based on functionality, the system has been categorized into the following modules:-

- Transmitter
- Robotic platform
- Robotic arm
- Intelligent sensing

Each of the modules are discussed in the following sections.

2.1 Transmitter

Transmitter is a part through which robotic platform and robotic arm is controlled. The robotic platform is controlled by micro switches and accelerometer. Fig.2 shows the functional block diagram of the Transmitter end.

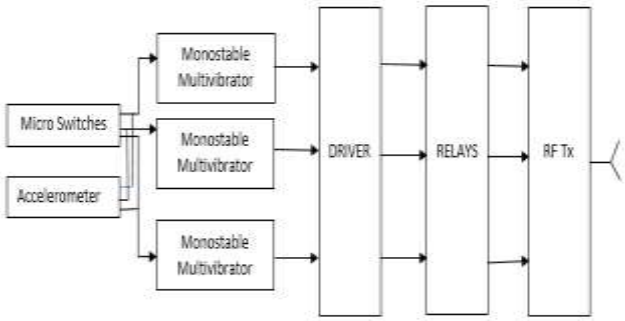

Fig.2: Block Diagram of Transmitter

Micro switches are the small push button kind of switches which closes the circuit and allows the current to pass through until the switches are being pressed, whenever the switch is released the circuit breaks and current flow ceases. An accelerometer [4] measures gravitational force or acceleration. By tilting an accelerometer along its measured axis, one can read the gravitational force relative to the amount of tilt. Most accelerometers available today are small surface mount components. There are three axes that can be measured by an accelerometer and they are labelled as X, Y and Z. Each measured axis represents a separate Degree of Freedom (DOF) from the sensor, thus a triple axis accelerometer might be labelled as 3 DOF.

The 555 timer Integrated Circuit is designed to function as a one shot multivibrator, the circuit has only one stable state, whenever the circuit is triggered it generates the pulse for a fixed duration of time and settles back to its stable state which is low in this design. ULN2004 is the driver IC used which internally consists of Darlington pair transistors whose output is sufficient to drive the relays.

An Application Specific Integrated Circuit is used as an RF transmitter [10] which has 4 input lines and single output line. Triggering the input lines the RF transmitter output will be a modulated signal for the message signal corresponding to 17 KHz, 19 KHz, 22 KHz and 25 KHz.

There are 3 switches used which controls the front, right and left movement of the robotic platform, also accelerometer is connected in parallel which has 3 DOF and hence controls the left, right and front movement of platform. The control signal is generated through accelerometer or switches which triggers the one shot multivibrator, which in turn provide inputs to the driver IC, output of which is sufficient to drive relays which in turn triggers the RF Transmitter, the modulated signal is transmitted through telescopic antenna.

An IR transmitter [11] is used to control the Robotic arm, M708/708A PCM Remote Control Transmitter IC is used to design IR transmitter. Upon receiving the IR signal the arm will perform the following operations.

Arm down
Jaws Open
Jaws close and pick the object
Arm up

Fig.3 shows the photograph of the Transmitter Module

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Fig.3: Photograph of Transmitter Module

2.2 Robotic platform

Robotic platform is a movable part of the robot which carries the robotic arm. The platform has 2 DC motors and a castor wheel. The platform is wirelessly controlled to move front, back, left and right directions, also the platform can be made to move at desired angles. The algorithm used to move the platform at different directions is given in the Fig.4 and block diagram for the control of platform is shown in Fig.5.

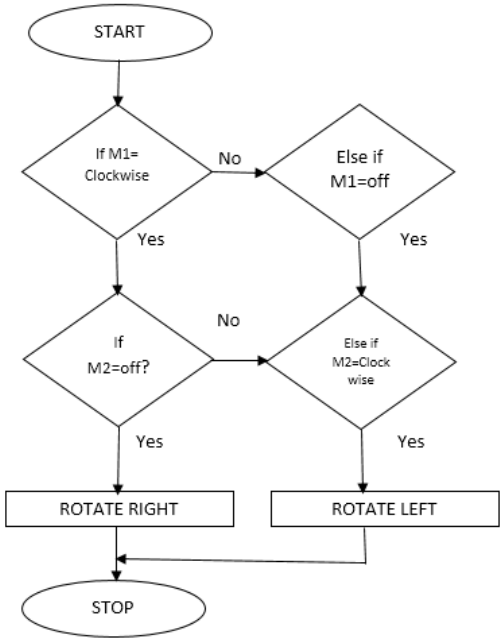

Fig.4: Flow chart of algorithm to control platform

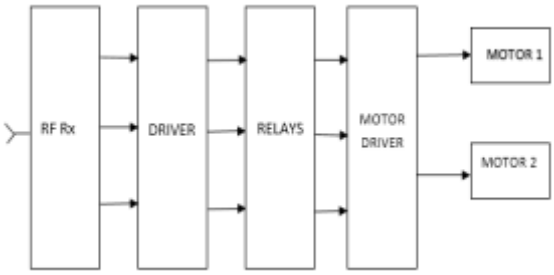

Fig.5: Platform Control

The RF receiver [10] is a ASIC which has 1 input line and 4 output lines,it receives the signals through loop antenna, upon receiving 4 different frequencies of signal appropriate output line is enabled.

The RF receiver receives the modulated signals, demodulates them and triggers the driver, the output of the driver is sufficient to drive the relay which in turn triggers ULN293D motor driver which controlls 2 DC motors thus controlling the robotic platform.

2.3. Robotic ARM

Robotic arm is the main part of the module, this is mounted over the platform. Arm can move in upward and downward directions, also it is equipped with jaws to facilitate the picking of objects. The entire action of the arm is achieved by using 2 DC motors [9]. The functional block diagram of the robotic arm control is shown in Fig.6.

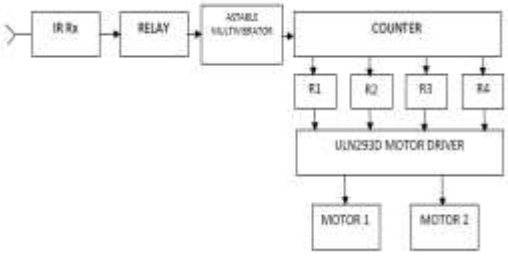

Fig.6: Robotic Arm Control

Infrared receiver [11] receives the signals from the IR transmitter , IR receiver is the photo transistor, upon receiving the IR signals the photo transistors conduct and triggers the relay, relay triggers the astable multivibrator which continuously generates the pulses, these pulses are received by decade counter IC 4017, IC 4017 takes the clock pulses and steps the output from negative to positive in series of 10 steps, with only one pin being on at a time. The Motor 1 controls the up and down movement of arm and Motor 2 controls the jaw movements.

2.4 Intelligent Sensing

The system is equipped with high temperature detection and alert system, high temperature can harm the robot also it may harm the person who is using the robot, hence an thermistor [9] is used which senses the presence of high temperature and alerts the user through beep and also displays the condition on LCD.

Since robot is an electronic device, presence of rain or water would destroy the robot, hence to avoid this an rain drop sensor is interfaced which indicates the presence of water through a beep and also displays the condition on LCD. Fig.7 shows the interfacing logic for thermistor and rain drop sensor.

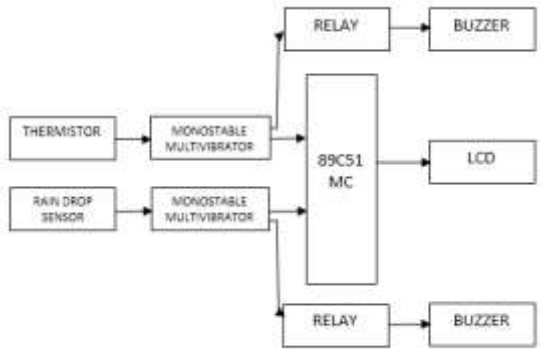

Fig.7: Intelligent Sensing

III. RESULTS AND DISCUSSION

A low cost, user friendly robot which includes a robotic platform and robotic arm is developed which can assist the differently abled people and aged individuals to lead their life more comfortably without relying upon others to do simple tasks, sensors are interfaced to detect presence of water and fire. Fig 8 shows the photograph of developed robotic arm. The final results of the work is observed and are tabulated in Table 1.

Table. 1

Clock Pulse	Relay Activated	Motor Activated	Arm Action
1	R1	Motor 1	Arm Down
2	R2	Motor 2	Jaws Open
3	R3	Motor 2	Jaws Close
4	R4	Motor 1	Arm Up

Fig.8: Developed Robotic Arm

After experimental analysis the developed robotic arm is found working satisfactorily, the arm is useful for differently abled and elderly people.

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