Smart phone based industrial robot using raspberry pi

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Abstract: *This paper presents the implementation of wireless arm robot using Raspberry Pi . The wireless control has been implemented with sBluetooth technology. Some of the main features of Bluetooth are to establish wireless communication medium between the arm robot and the mobile phone. The hardware system is based on the Raspberry Pi microcontroller interfaced wirelessly with Android platform via a Bluetooth module. The user can send the control instructions to the robot from the mobile phone by using Bluetooth technology. As soon as the instruction is received by another Bluetooth at the receiver end, Raspberry Pi microcontroller will come into action and will start the motor drivers so that the Robot starts moving as per the instructions sent by the user/ operator from mobile phone. In addition to the above qualities of the arm robot, its intelligence is further upgraded in this design by making use of a color sensor to identify and handle the required color objects and Ultrasonic sensor to change the direction of robotic vehicle if any obstacles are present in their path.*

Keywords— *Arm Robots, Raspberry Pi, Color Sensor, Ultrasonic Sensor*

I. INTRODUCTION

The importance of robotics in 21st century is increasing day by day to reduce human mistakes in their daily tasks because of their ability to do much difficult task.The industrial robot made under this project can move in both forward and reverse direction and can turned in left and right directions. Mobile robots are generally those robots which can move from place to place across theground. Mobility gives robot a much greater flexibility to perform new, complex, exciting tasks. The world doesnot have to be modified to bring all needed items within reach of the robot. The robots can move where needed. Nowadays, robots are increasingly being integrated into working tasks to replace humans especially to perform repetitive tasks. The mobile robots are currently used in many fieldsofapplicationsincluding office, military tasks, hospital operations, dangerous environment and agriculture. Besides, it might be difficult to the worker who must pick and place something that can affect badly. Painting has similarproblems to welding due to the use of toxic chemical products, assembly operation: When we assemble a chipwe need to be very precise because of very fine wires which require very precise and accurate tasks which ahuman cannot handle but, on the other hand, is easy for a robot. This paper describes thedevelop a real time mobile robot system based on using Bluetooth technology. With the help of this technology, we can operate a robot over a long distance where human cannot enter and do the activity without any risk to human lives. This prevents wiring for headset, sensor measure the distance of target objects or materials through the air using "non-contact" technology. They measure distance without damage and are easy to use and reliable.

This system comprises of Color sensor, Ultrasonic sensor, Raspberry Pi, Servo motor and Bluetooth module. In this process, we are using Raspberry Pi microcontroller to control the robotic arm. On the other hand, Ultrasonic sensor is used to change the direction of the robotic vehicle. Industry utilization and manufacturing also defined the significance of this project.

II. WORKING

In many industries it is required to sort objects from a mixture of materials. This machine is a demonstrator of industrial object sorting robot based on color of object and it measures the distance of the object. In the transmitter, we control the robotic arm through android application in mobile phones with the help of Bluetooth. In the receiver side, it receives the signal through Bluetooth module and it sends command to the photodiode based color sensor is attached with this system for detecting the color of the object.This type of command is send to robot and this robotoperates according to command. Raspberry Pi is the central processing unit, which controls all the functions of other blocks in this system. Raspberry Pi takes or read data from color sensor and controls the functions of the whole system by manipulating these

data. Raspberry Pi controls the gripper motor on the robotic arm, as per the signal from color sensor. Raspberry Pi can understand the color of the object, it controls the arm motor to move towards the specified box, again control the gripper motor to pick and place the specified object. On the other hand, if any obstacles is present in that path Ultrasonic sensor changes the direction of the robotic vehicle.

III. BLOCK DIAGRAM

Block diagram of industrial robot with Bluetooth using Raspberry Pi microcontroller is as shown in figure. Ultrasonic sensors are connected to the processor which is the input block is used to find the distance of the object. There are three servo motors which are used in industrial robot. Microcontroller gives output in few milli amperes (500ma),it is not enough to drive the high power devices such as servo motor. Hence to amplify these outputs a motor driver L293D IC is used. The last block of the block diagram of industrial robot with color sensor, here color sensor is used to identify the color of the object and robotic arm performs the pick and place mechanisms.

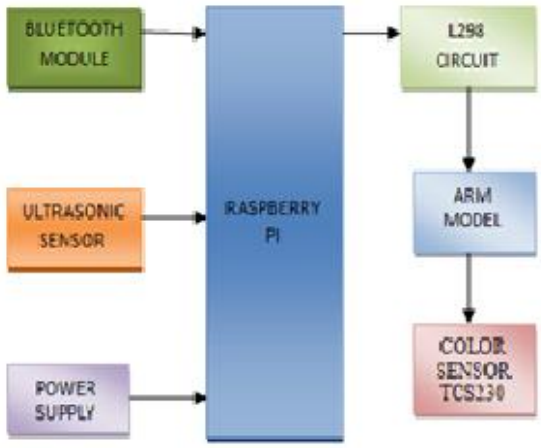

Figure 1-Transmitter

Figure 2-Receiver

a. RASPBERRY PI

The Raspberry Pi is manufactured through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. All of these companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other pieces by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers. The Raspberry pi has a Broadcom BCM2836 system on a chip (SoC), which includes an a quad-core Cortex-A7 cluster. The Cortex-A7 MP Core processor is a high-performance, low-power processor that implements the ARMv7-A architecture. The Cortex-A7 MP Core processor has one to four processors in a single multiprocessor device with a L1 cache subsystem, an optional integrated GIC, and an optional L2 cache controller. The Raspberry Pi foundation has finally released an upgraded version of the Raspberry Pi. Raspberry Pi 2 model B features much of the same ports and form factor as Raspberry Pi Model B+, by replaces Broadcom BCM2835.To connect the mobile robot to the Internet and the installation of the various programs, we need a certain computer specifications, in this project we used microcomputer called 'Raspberry Pi' because of its good specifications and possibilities and high flexibility in dealing with different programs.

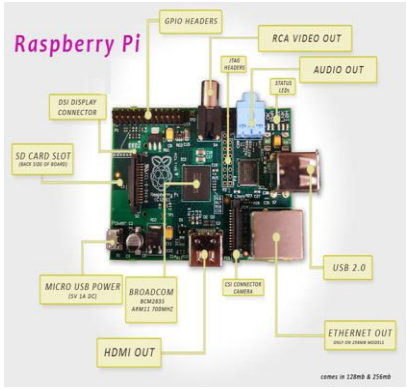

Figure 3-Raspberry Pi module

b. COLOR SENSOR

In this concept the color sensor is used that sense the different type of color such as

- White
- Black
- Red
- Blue.
- Green.
- Yellow.

The color sensor identifies color and gives serial output of white, black, red, blue, green, yellow etc. It can identify 16.7 million color shades giving RGB value for the detected color. The detected color

is identified as amount of three primary color values namely Red, Green & Blue with 8 bit accuracy for each primary color. Any color can be separated or combined into three primary colors Red, Green and Blue using the RBG values. The output of this color sensor is connected to Raspberry Pi.

Figure 4-color sensor

c. ULTRASONIC SENSOR

Ultrasonic sensors "are based on the measurement of the properties of acoustic waves with frequencies above the human audible range", often at roughly 40KHz.It measures distance by sending out a sound wave at a specific frequency and listening for soundwave to bounce back. Ultrasonic sensor provides precise, non-contact distance measurements within a 2cm to 3m range. It works in any lighting condition, making this a good choice to supplement infrared object detectors.

Figure 5-Ultrasonic sensor

d. BLUETOOTH MODULE

Bluetooth is defined as being a short-range radio technology(or wireless technology) aimed at simplifying communications among internet devices and between devices and the internet. It also aims to simplify data synchronization between internet devices and other computers. Bluetooth technology requires that a low-cost transceiver chip be included in each device. The transceiver transmits and receives in a previously unused frequency band of 2.45 GHz that is available globally -- with some variation of bandwidth in different countries. In addition to data, up to three voice channels are available. Each device has a unique 48-bit address from the IEEE 802 standard. Bluetooth connections can be point to point or multipoint. With class 1Bluetoothdevicestransmitting at 100mW, which have a standard range of approximately 100meters.

Figure 6-bluetooth module

e. SERVO MOTOR

Servo means to an error sensing feedback control that isused for correcting the performance of any type of system. Basically servo motors thatis equipped with a servo mechanism for the purpose of controlling precise angular position. These motors usuallyhave a rotation limit ranging from 90° to180°. But the main drawback is that servos do not rotate continually to performcertain tasks. The rotation of these motors is restricted inbetween the fixed angles. So the **Servos** are also used forprecision positioning. There are many applications whereservos are used such as in robotic arms and legs, sensor scanners, RC airplanes etc.

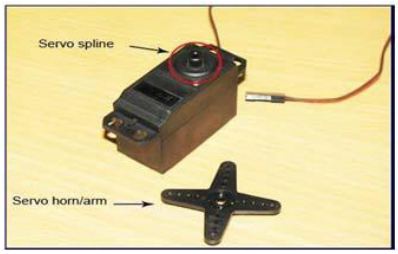

Figure 7-servo motor

f. CHASSIS

g.

Another word for chassis is base. All components of the robot are attached directly to the chassis; therefore, a strong yet light chassis will be ideal. Chassis can be made from many different types of materials; some common types are aluminums, steel, acrylic, plastic and high density polymer.

Figure 8-chassis

h. POWER SUPPLY

The device is powered by a 5V micro USB supply. Exactly how much current (mA) the Raspberry Pi requires is dependent on what you connect to it. We have found that purchasing a 1.2A (1200mA) power supply from a reputable retailer will provide you enough power to run your Raspberry Pi. Typically, the model B uses between 700-1000mA depending on what peripherals are connected; the model A can use as little as 500mA with no peripherals attached. The maximum power the Raspberry Pi can use is 1 Amp. If you need to connect a USB device that will take the power requirements above 1 Amp, then you must connect it to an externally-powered USB hub.The power requirements of the Raspberry Pi increase as you make use of the various interfaces on the Raspberry Pi. The GPIO pins can draw 50mA safely, distributed across all the pins; an individual GPIO pin can only safely draw 16mA. The HDMI port uses 50mA, the camera module requires 250mA, and keyboards and mice can take as little as 100mA or over 1000mA! Check the power rating of the devices you plan to connect to the Pi and

i. BACKPOWERING

Backpowering occurs when USB hubs do not provide a diode to stop the hub from powering against the host computer. Other hubs will provide as much power as you want for each port. Please also be aware that some hubs will backfeed the Raspberry Pi. This means that the hubs will power the Raspberry Pi through its USB cable input cable, without the need for a separate micro-USB power cable, and bypass the voltage protection. If you are using a hub that backfeeds to the Raspberry Pi and the hub experiences a power surge, your Raspberry Pi could potentially be damaged.

j. ROBOTIC ARM

The term robot comes from the Czech word Robota, generally translated as “forced labor”. This describes the majority of robots fairly well. They handle tasks that are difficult, dangerous or boring to human beings. The most common manufacturing robot is robotic arm. The industrial robot with six joints closely resembles a human arm-it has the equivalent of a shoulder, an elbow and a wrist. This type of robot has six degrees of freedom, meaning it can pivot in six different ways. Robotic hands often have built –in pressure sensors that tell the computer how hard the robot is gripping a particular object. In this project, the robotic arm works according to the color sensor to perform the pick and place operations. Here we use three servo motors to rotate the robotic arm in 360 degrees.

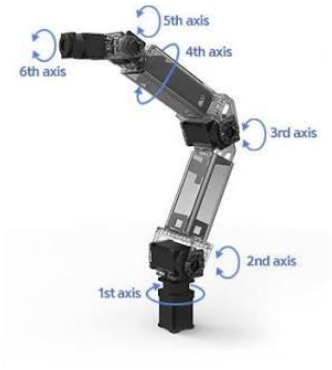

Figure 9-Robotic arm

k. MOTOR CONTROL CIRCUIT

MCU cannot operate a dc motor directly. It operates the motor through the interfacing circuits. Here IC L293D acts as an interfacing unit between MCU and the DC motor. One L293D can control two DC motors. So in order to drive five motors three L293Ds are used. In the circuit shown above the pins of IC L293D is connected to RB0, RB1, RB2 and RB3 of the MCU to drive the base motor arm motor 1respectively.

l. MOTOR DRIVER (L293D)

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V .Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input become high, the associated drivers will get enabled, and their outputs will become active. These outputs are in phase with their inputs. When the enable input is low,

those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. The H-bridge (or "full bridge") is so named because it has four switching elements at the "corners" of the H and the motor forms the cross bar. The basic bridge is shown in the figure to the right.

The key fact to note is that there are four switching elements within the bridge. These four elements are often called, high side left, high side right, low side right, and low side left (when traversing in clockwise order).The switches are turned on in pairs, either high left and lower right, or lower left and high right, but never both switches on the same "side" of the bridge. If both switches on one side of a bridge are turned on it creates a short circuit between the battery plus and battery minus terminals. This phenomenon is called shoot through in the Switch-Mode Power Supply (SMPS) literature. If the bridge is sufficiently powerful it will absorb that load and your batteries will simply drain quickly. Usually however the switches in question melt.

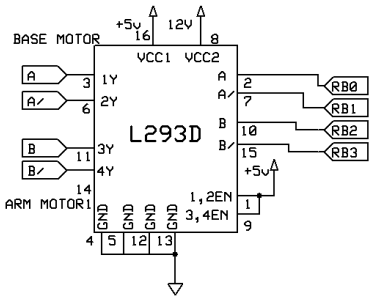

Figure 10-Motor Driver

IV. SOFTWARE DESCRIPTION

This undertaking is executed utilizing taking after software's:

- C++
- Qt Creator
- Raspbian OS

V. ADVANTAGES

- Positioning & locating objects
- Pick and place mechanism
- Used in hazardous place

VI. APPLICATIONS

- Color Detection & Sorting operations like brick sorting, tablets separation
- To separate vegetables according to their color sorter that looked at each candy and put it in a bin based on its color.
- Avoids separation of medicines in pharmautical industries.
- Robotics color detection.

VII. CONCLUSIONS

The system has been successfully designed and it has the capability to rotate $360^0$and handle the required task. It can take specific colored object, hold it and put it to a particular station even to some height using RGB color sensor. Color sensing section performed two main tasks; object's detection and color recognition. The cost effective system was designed to perform the continuous and reliable tasks without human errors using the simplest concepts. The robotic sorting systems are useful in industries and different household activities. Since this system is mainly controlled by the Raspberry Pi Microcontroller, the results obtained are more reliable and faster.

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