

Robotic Cubes for the Intellectual Simulation of Kids

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Abstract

*Block bots are modular mechanical robotic cubes, permitting children to create solid computational thinking abilities. The blocks are constructed with PCB boards, each of size 7*7, which makes it simpler to play with. Similar to the arrangement of building cubes, these automated blocks should be associated in their proper positions to make it work. In this fun based learning project, 6 blocks have been designed, with specific function. Those functions will inspire children to play and enhance their desire to innovate.*

Key-words: Robotic Blocks, Arduino Nano, Sensors.

1. Introduction

A survey is taken with colleagues, friends, and relatives. Their interest towards building cubes is really astounding and this survey paves way to innovate block bots. Some electrical components inside the PCB boards should be included to make things more interesting and practical. PCB is designed and electrical components are added to transform it into a robotic block. How to play with these robotic blocks? In the similar way of playing with building blocks. It will operate electrically by

simply stacking the appropriate blocks on their appropriate position. Children were allowed to understand the functions of electrical components used in this robotic block even at a young age by playing with it. Our main objective is to bring back the culture of playing with hardware toys, as no child today is seen without an Android phone, which contributes to addiction. A study says that Pathological gaming showed comorbidity with consideration issues [18]. Our second objective is to give Efficient “Fun-Learning” toy that not only encourages them to play but should also bring a curiosity in them to know what’s happening behind and how it functions, this will help them in their future on whatever they learn. They can learn about some electrical components and their uses in earlier age itself.

2. Blocks

Block bots are cube-shaped robotic blocks that are intended to draw children to hardware toys, as their current interest is in software gaming. An idea is to construct robotic block each with specific function in concatenation forms as a working model. Children can choose two different choices to play with. There are five types of blocks. Battery block, Processor block, Motor block, IR block and LDR block. Each blocks communicate with each other through pogo pins. Male pogo pins are attached in Processor block. This blocks acts as a brain to all other blocks. All other blocks are linked to this processor block through female pogo pins [15].

A. Benefits

The following are some of the positives about using block bots,

Actual advantages: toy blocks develop fortitude in a kid's fingers and hands, and improve eye-hand coordination. They likewise helps in teaching youngsters.

Social advantages: Block play encourages kids to make friends and play together, and it is a pleasurable activity. Blocks are advantage for kids since they empower collaboration and creative mind. Imagination can be a joined activity that is significant for social play.

Scholarly advantages: youngsters can conceivably build up their vocabularies as they figure out how to depict sizes, shapes, and positions. Math abilities are created through the way toward gathering, adding, and taking away, especially with normalized blocks, for example, unit blocks. Encounters with gravity, equilibrium, and math gained from block bots additionally give scholarly incitement.

Imaginative advantages: youngsters get inventive incitement by making their own plans with blocks.

Instructive advantages: They would be motivated to learn about electrical components even though they are young.

B. Uses

These block bots are nothing but simple electronic blocks, which are specially designed for kids based on the motive of fun based learning, these bots operates when it gets a signal (light /nearby object). This simple toy not only encourages children but also elders to play. It inculcates in children and elders (who are unfamiliar with simple electronic components) a basic understanding of electronic components and how to manage them. Children would be more skilled in their youth as a result of learning experience, and this would allow them to invent new ideas.

3. Algorithm

At first our circuit design is tested in bread board to find whether all the components are in working condition. After this phase, the circuit design is carried on to the PCB boards. The circuits on PCB boards are built in Eagle software on OHP sheets. Those OHP sheets are given in a company to construct the PCB boards. After getting those PCB boards, checked for any unfortunate short circuits on PCB boards, after founding it null, then soldering and others works have been taken place.

1. Processor Block

At First Processor block is made, as it is the only block that will be interconnected to all other blocks. The Arduino Nano (ATmega328) this can be operated by an external 5V controlled power supply. Arduino Nano can be programmed with embedded C at port COM 3. Of the 8 analog input pins, input is taken from A0 for LDR sensor. Of the 14 digital input pins input is taken from D2 for IR sensor. The circuit designed here is H-Bridge circuit, used to run two 100 rpm dual shaft motor at a time. IC L293D is connected with Arduino for the execution. Single stranded wires are used for connection uniting the PCB boards and then soldered.

Arduino Nano and IC L293D are placed above female pogo pins which were soldered inside the PCB boards. To make the work easy in using Arduino Nano and IC L293D. The processor block is connected with all other blocks using the female pogo pins present in those blocks.

Without this processor block no other block can function because this is the block which can transfer information to all other blocks.

2. Battery Block

The next block to be designed is battery block which will act as the power source for the entire block. The battery used here is Lithium-ion battery of 3.7 volt each. Those batteries are rechargeable battery, we will recharge it by keeping it is a single cell battery holder through TP4056.

The reason for using TP 4056 is to protect the cell from over and under charging. It also has programmable charge current of up to 1A. The positive terminal of the battery is wired to pin 8 of the ICL293D. The negative terminal of the battery is linked to the Arduino's ground. Automatic recharge is a functionality of the TP4056 IC. When the battery voltage drops down to approximately 4.05

3. Motor Block

The motor block contains 100 r.p.m dual shaft motor within it. Two motor blocks are made here to keep it on either side to make it run. Two motors can be enabled at the same time using the H-bridge circuit. The two motors gets input from pins 3,6,11 and 14 in IC L293D.

4. LDR Block

This block will act as the input block which gets input from the user and pass it to Arduino in the processor block. LDR module is connected with analog pin A0 of the Arduino. The LDR module collects the Light intensity at every instantaneous point of time (either from the surrounding or from the user by turning on the torch) and gives the input to Arduino so that the signal can be modified based on certain condition. The condition is if the intensity is greater than 600 then the Arduino signals the motor to run. On the flip side if the intensity is less than 600 then the Arduino signals the motor not to run.

5. IR Block

This block will also be acting as another input block that gets input from the user and pass it to the Arduino for further processing and modification. IR module is connected to the digital pin D2 of the Arduino in the processor block. The IR sensor in the IR block passes infra-red light and detects

for any nearby object at every instantaneous point of time. If any nearby object is detected then the input is carried on to Arduino so that the Arduino can process the input from IR block and signals the motor in the motor block to run. On the other side if no object is detected nothing is taken to Arduino and therefore no further process takes place.

4. Inheritance

A. Existing

The name of the existing product is cubelets. Cubelets are modular robotic blocks similar to manual building blocks but are small in size (generally of 4*4 size). The cubelets contains more blocks, which successively leads to more functionality. Neodymium magnets have been used to fix the blocks in the appropriate position. And the cost of these blocks is high. [20]

Cubelets consists of three types' blocks: ACT block, SENSE block, THINK block, BATTERY block.

1. SENSE Block

Usually, sense blocks are black in color. These blocks acts as input blocks. These blocks get input from user. As said early these SENSE blocks contains many types of sense block, there may be. IR sense block, ultra-sonic sense block, LDR sense block and many more.

2. THINK Block

Usually, think blocks have different colors except black. These blocks act as little brain. These blocks get input from the sense blocks. These blocks process information and can modify the information. As said early these blocks also contains many sub types.

3. ACT Block

Usually, ACT blocks are transparent in color. These blocks acts as output block. These blocks get input from THINK block. These blocks do things like spin around, lights up, make sounds. These blocks also contain many types of sub blocks.

4. Battery Block

BATTERY block supply power to all the other block. This block can be recharged by using USB cable.[20]

THINK block, ACT block and BATTERY block are the important blocks which can't be replaced. Sense block can contain any sensors within it.

B. Proposed

The name of the introduced model is “Robotic cubes for the intellectual simulation of kids” also called as “Block Bots”. These block bots are also similar to the modular robotic blocks. These block bots are large in size (7*7 in size). The block bots contain FIVE types of blocks. Instead of Neodymium magnets, pogo pins are used to fix the blocks in appropriate positions. The cost of these block bots are also less. These blocks are not classified based on color.

Block bots contain five types of blocks: BATTERY block, IR block, PROCESSOR block, LDR block, MOTOR block.

BATTERY blocks supply power to all other blocks. This block uses either two 3.7V li-ion battery or single 9V triple A battery.

IR block senses whether there is any nearby object by passing infra-red light and gives this input to the processor block. This block acts like input block. This block gets input from user

LDR block senses the intensity of light in the surroundings and gives the input to the processor block. This block also acts like input block. This block also gets input from user.

PROCESSOR block gets input from the IR and LDR block. This block also acts as little brain. This block can process and alters the given input.

MOTOR block, it is like the act block in the cubelets. This block acts as the output block. This block get input from the PROCESSOR block.

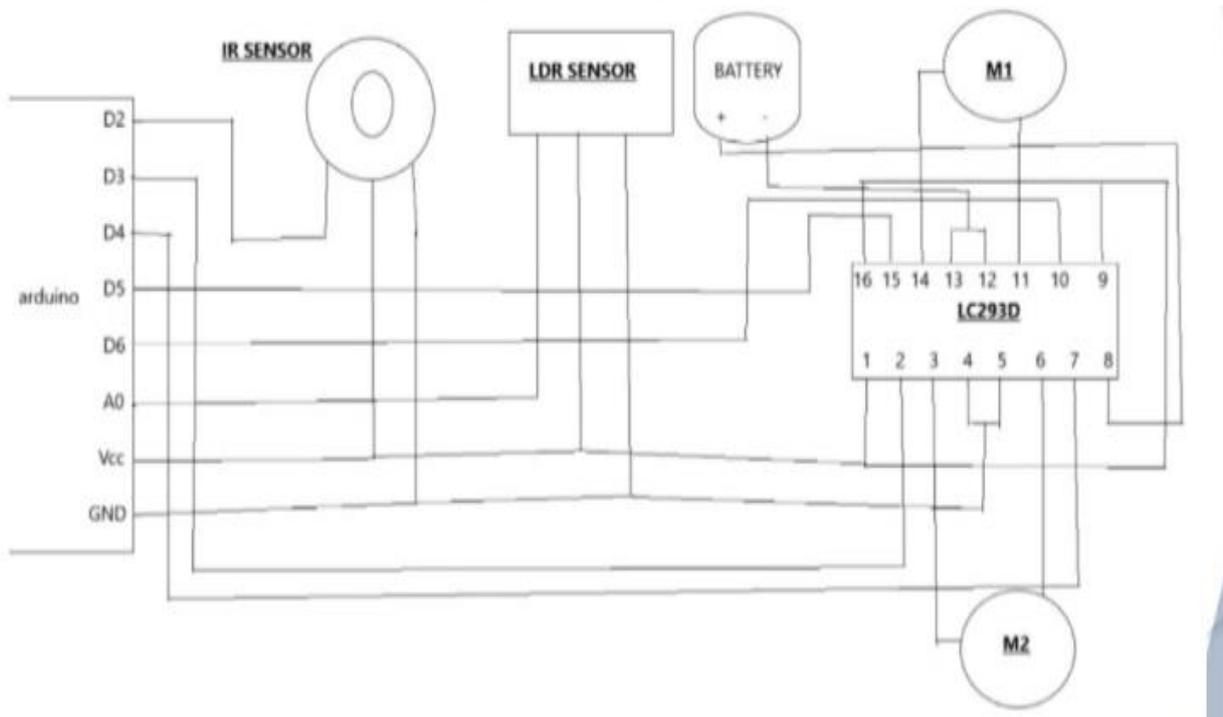
All the five blocks should be combined to run the combined robotic blocks.

An empty block with a character image in its outer layer is added with main blocks to be kept in the top, to make the product more attractive and fabricate attention to play.

5. Delineation of Blocks

In the below figure 1 it represents the snapshot of our circuit diagram.

Fig. 1 - Block Diagram Used



The circuit we map out here is H-Bridge circuit. This circuit is used to run two motor at a time.

In the Processor block it contains Arduino Nano and IC L293D. Arduino Nano is supplied with 9 voltage in Vin. Analog input is given from LDR sensor to Arduino at A0 pin. Digital input is given from IR sensor to Arduino at D2 pin.

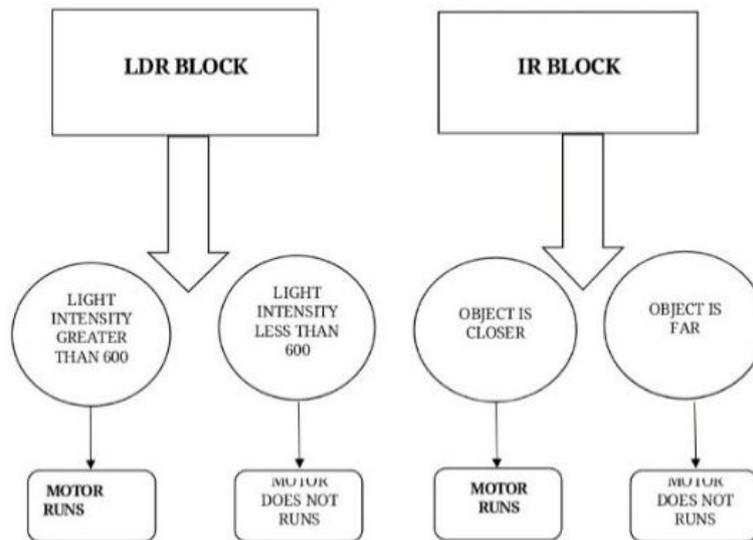
The two sensor blocks are LDR sensor and IR sensor [17]. The motor block contains 100 R.P.M. dual shaft motor. From light and distance, the two sensor blocks can gather data from the environment.

Pogo pins are used to pass this data to the processor block. Then the information is taken to the motor block and gives the command to run or not. The battery block can be recharged through TP 4056 using a single cell battery holder. Each and every block should perform its specific function then only the combined robotic block will run. If there is any failure in any of the block then the combined robotic block will not run.

6. Functioning of Blocks

This flow map depicts the process of working. (figure 2)

Fig. 2 - Flow of Working



As how a man cannot live without a heart, this project also cannot operate without the Battery block. It comprises of a combined 3.7V Li-ion battery or a 9V triple A battery that provides all of the other blocks with the required power. These lithium-ion batteries are rechargeable battery. The IC TP4056 will charge it separately.

The processor block is the brain of the project. It consists of Arduino Nano and IC L293D. The Arduino receives data from the IR and LDR blocks and sends it to the L293D motor driver IC. The requisite programming is uploaded to Arduino Nano via USB cable, and it will receive input from either the IR or LDR block at any time, activating the motor block. [1]

Motor block reacts to the input given by the processor block. It consists of a dual shaft 100 RPM motor. Two motor blocks are present, one in the left corner of all other blocks and the other in the right corner. It has wheels which can be used to move the block.

LDR block consists of LDR module. The LDR module's function is to sense light intensity and give a high value of input (if light intensity is high) to the processor block, which then drives the motor block.

If the intensity of light is above certain value the motor block will run otherwise it will not run.

The IR module is part of the IR block. The acceleration of an object close to the IR module is detected. It sends a high value of feedback to the processor block that drives the motor block (if it detects any object nearby). The motor block would not turn if no object is found.

The Program (source code), if the light intensity is greater than 600 it gives instruction to the motor block to run. For LDR sensor analog output is taken. Whereas in case of IR sensor digital output is taken. It checks whether the distance it is closer or not [16].

A. Testing Part

With the aid of a bread board, each electrical part is first individually evaluated. Analysis is performed to determine whether any of the modules are functioning or not. Arduino Nano with IC is tested using a basic led program. The PCB boards are checked to see if any unnecessary paths have been shortened. During testing, the execution of the LDR and IR sensors is calculated. In embedded C the output of LDR and IR module is examined through serial monitor. Eagle software is used to design PCB boards. The testing part table is shown in figure 3.

For testing purpose after assembling all the six blocks, using multimeter short circuit connectivity is tested. Then all the testing has been done and our product is ready to be displayed.

Arduino programming software has been installed to check the working of LDR and IR sensor. This Arduino software uses embedded C.

Figure 3 - Testing Part for Sensors

Sensors	Input	Output
LDR sensor	If (intensity of light > 600 lux)	Motor runs
LDR sensor	If (intensity of light < 600 lux)	Motor does not run
IR sensor	If (any object detected near sensor)	Motor runs
IR sensor	If (no object detected)	Motor does not run

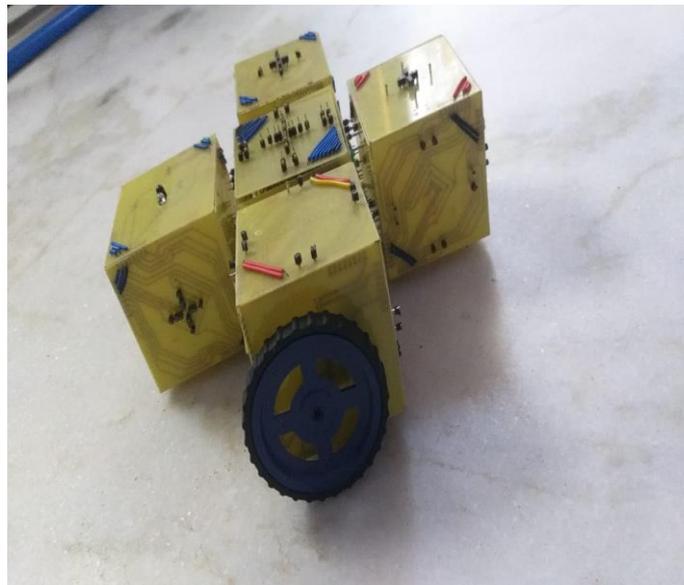
LDR sensor and IR sensor is tested separately using serial monitor. The testing part done in embedded C serial monitor is shown in below table.

B. Future Scope

The robotic blocks named block bots, able to move or stop under some required condition. All the six blocks, battery, processor, two motor and sensor blocks are connected in their appropriate positions. In consonance with programming, the robotic block will shift if the light strength is greater than 600, i.e. if a torch is shown. When the flame is turned off, it will not move. It may also be shifted in other ways; if an object is brought closer to the IR sensor block, it will move; if it is brought farther forward, it will stop. In the future, devices with more than two states will be created [15]. In the future, an ultrasonic block, for example, may be produced and applied to this Product. The finished product with the main blocks is shown in figure 4.

The final combined model is shown below in figure 4,

Fig. 4 - Final Product



This is the eventual outcome which has been delivered, to this in future more squares can be made and added.

A new block have been designed, an empty cube which doesn't contain any electrical components in it. But it is made up of PCB boards only. To make the product more appealing, some blocks have faces that imitate cartoon characters on their outer shell.

7. Conclusion

The block bots overall activity is based on obtaining, manipulating, and executing data based on certain parameters.

This course introduces SENSING block, MOTOR block, PROCESSOR block. It emphasizes an investigative approach, and helps users understand the most basic functionality of blocks

Working on this project was a great learning experience. Nowadays, children play games on their phones, which increases their stress and causes them to be constantly stressed. However, when playing with these block bots, children will believe that they are doing some kind of magic to drive these blocks, which will pique their interest in these block bots. Alternately, this will keep their mind in a calm state.

Our primary purpose is to teach STEM (science, technology, engineering, and mathematics) principles and skills to young children [19]. Which have been successfully achieved through this product.

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