e-NABLED

A mobile robot to help disabled people

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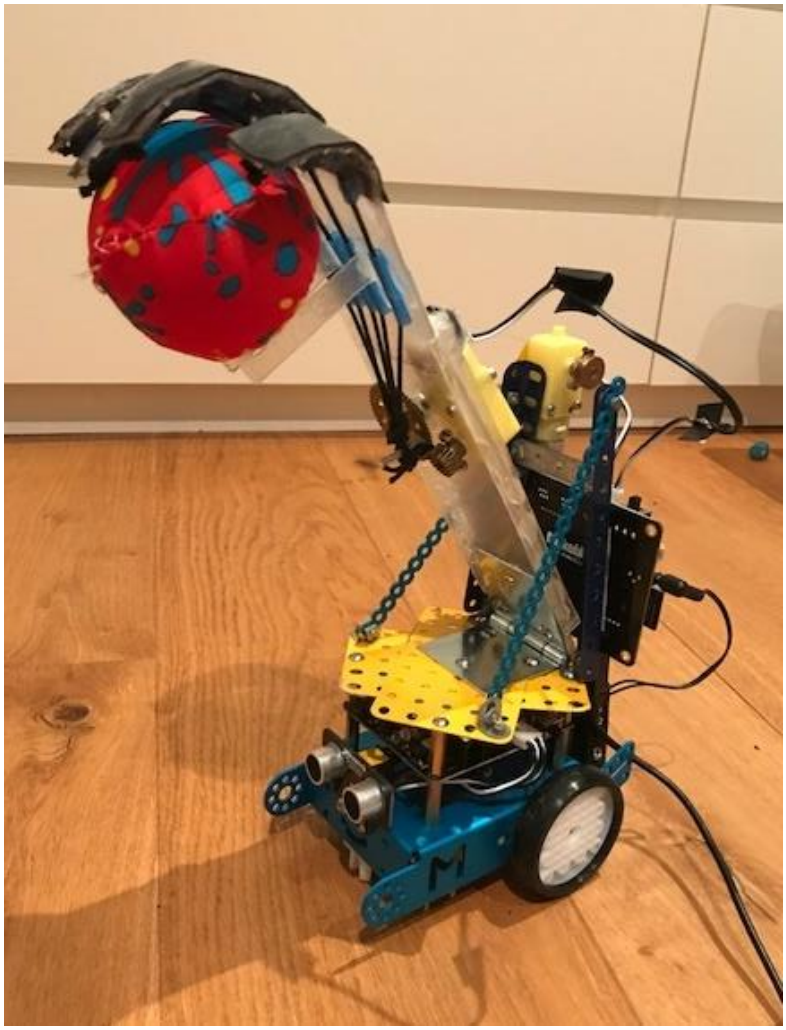


Introduction

This year I wanted to invent something to help less fortunate people.

It is estimated that 1 billion people have a disability in the world. Between 110-190 million have very significant difficulties in functioning. It is estimated that over 21 million people sit in a wheel chair. People's mobility is a big global problem.

After thinking of different inventions I concluded that one important problem would be to fetch things. This gave me the idea for a mobile robot which could help users pick up and move objects.

Background research

I searched the internet for a robotic arm. I could only find very expensive or very cheap versions. The advanced versions are too expensive for the majority of people ($10,000+). The cheap versions cannot move around.

Proposed solution

The invention includes a cheap robotic arm assembled on a cheap mobile robot. The solution can pick up and move objects to where the user wants them to be.

What is a M-bot?

A M-bot is a robot built for teaching kids how to program robots. It has different sensors and add-ons. The M-bot uses Arduino circuits and was great for this project as it has programming code and a mobile app that can do almost anything.

Planning the prototype

On YouTube I found cardboard robotic arms that could work. They looked very fragile though.

Figure 1 YouTube robohand

Instead of using a hand to control the fingers I decided to use a motor. To help disabled people the robot also needs to lift what it picks up. In my Dad's old Meccano set I saw a picture of a crane and I decided to use this design to lift the hand. I decided to use my brother's M-bot Arduino board to control both the gripping and lowering and bringing the hand back up.

I had a M-bot which I already knew how to program to move around. I wanted the robot to be easy to control and I decided to use a remote control and my smart phone as alternative controllers. It should be easy to put the robot arm on the mobile robot.

Building the prototype

It is important that the hand is sturdy and durable. Since the hand would be on a mobile robot it is also important that it is light. Testing the materials I decided to use plastic for the hand:

Material	Sturdy and durable?	Light?
Cardboard		XXX
Plastic	XXX	XXX
Wood	XXX	

I started by tracing my hand on paper. I folded the fingers to find out where I should cut the plastic fingers.

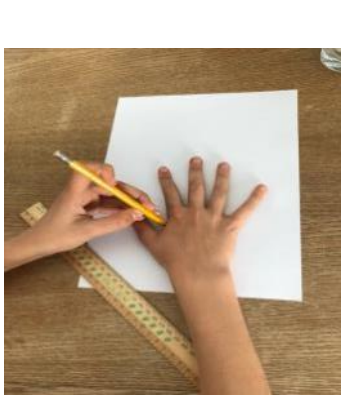


Figure 2 Prototyping

In the cardboard versions the cardboard helps the fingers release the grip when strings are released. I thought of using rubber bands on the back side of my plastic fingers. I could not find enough rubber bands, but in the garage I found a bicycle inner tube made of rubber. I decided to use this instead.

Figure 3 Testing rubber joint

The assembly of the hand was complicated with all the plastic parts, hot glue, rubber, straws and strings. With some holding support I managed to get it all together without burning myself.

Figure 4 Assembly and testing

Hand testing

I mainly studied how I could make the fingers grip well. I used a protractor to measure the angle needed to turn the wheel that I had assembled on the motor.

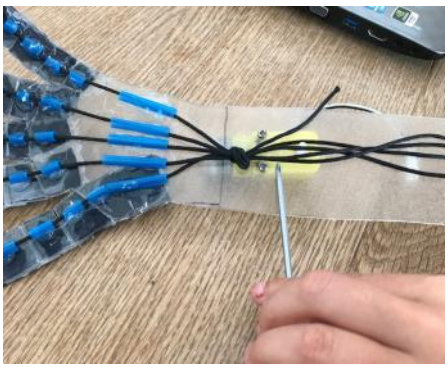


Figure 5 Measured degrees needed for motor to fully close grip

Testing the arm I realised that motor speed and time needed adjustment to ensure the robot hand closed properly. I found that increased speed made the gripping faster and stronger. Dad mentioned that higher speed meant a higher current to the motor which made it stronger.

Building the rest of the robot was fun. I also used Dad's old Meccano set to get it all together and the set also had some gears I used to increase the power of the grip.

Programming and testing

I have done several programming courses and programming the robot was fairly easy compared to building it. I had to try many times to get the timing right for the motors to ensure that the robot gripped enough, plus that the arm was lowered enough and brought up enough. I realised that I needed to be able to calibrate the position of the motors. I used the on board button to trigger stopping the motors. I could then calibrate the motor's position when the program was running.

I realised I had to use the M-bot ultrasonic sensor to trigger when to lower the arm. It could otherwise be tricky to see if you are far away. This also made it simpler since I did not have to communicate between the Arduino boards.

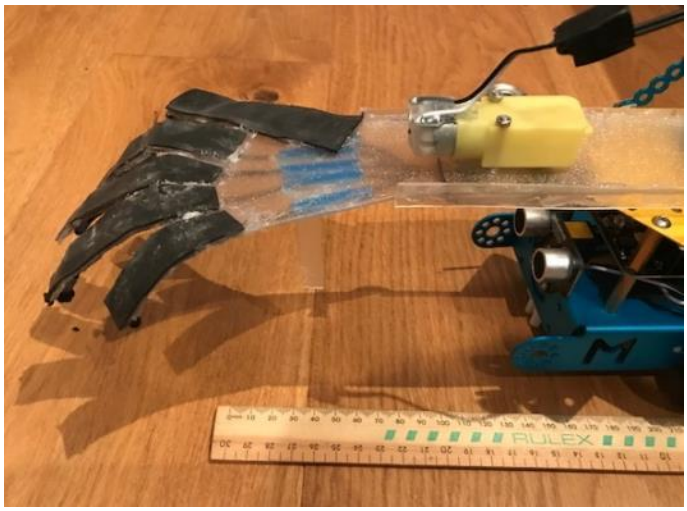


Figure 6 Measuring when Ultrasonic sensor should trigger gripping

Programming of the i-Phone app to control the mobile robot was easy since M-bot has ready modules which I have played with before.

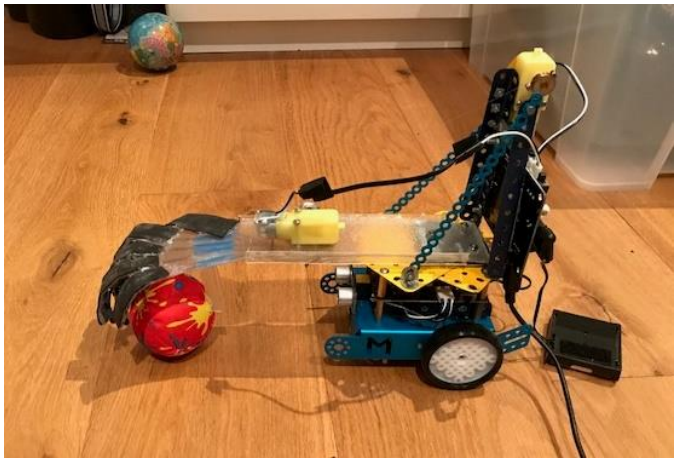


Figure 7 Testing

Potential improvements

An improvement could be to use a larger Arduino board instead of two smaller ones. This could reduce the component cost from $300 to maybe $200. This would make the invention even more available for less fortunate people.

Acknowledgements

I would like to thank my Science teacher Ms Cleary for arranging this event at our school. I'd also like to thank my dad for his support. He helped me do some of the more dangerous work (sawing plastic parts, some drilling, some hot glue gun work and soldering). He also helped me with the gear box assembly. I'd also like to thank my brother lending me his M-bot.

References

Disabled statistics https://en.wikipedia.org/wiki/World_report_on_disability

Wheelchair statistics https://www.wheelchairfoundation.org/programs/from-the-heart-schools-program/materials-and-supplies/analysis-of-wheelchair-need/

YouTube robohand https://youtu.be/c9FuPdl3xCE

Additional pictures

Figure 8 Cutting rubber and gluing with glue gun

Figure 9 Assembled fingers with straws and strings

Figure 10 Assembled arm

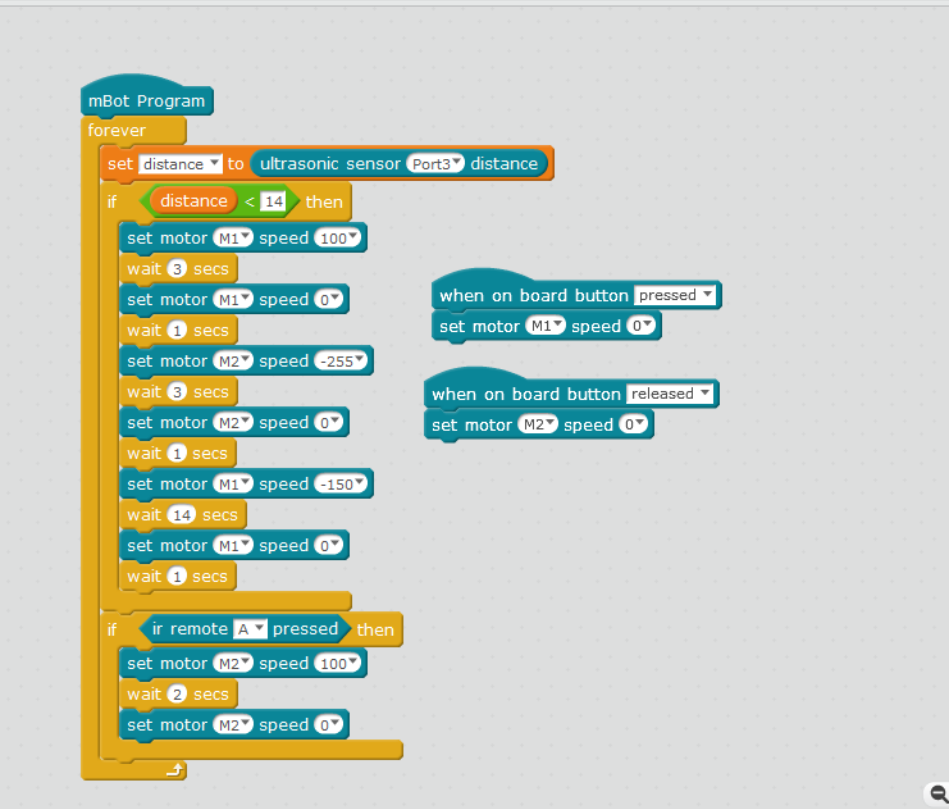


Figure 11 Robot arm code

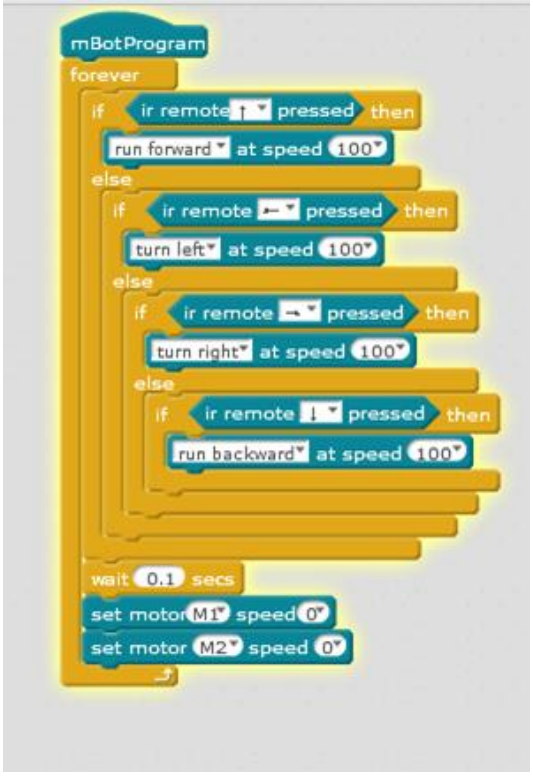
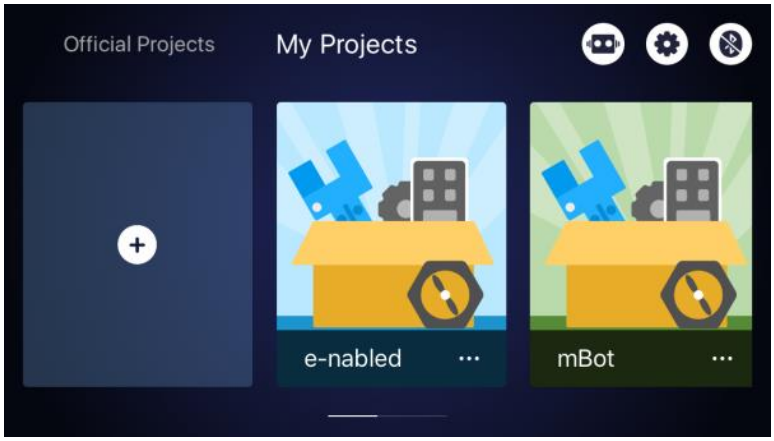


Figure 12 Remote control code



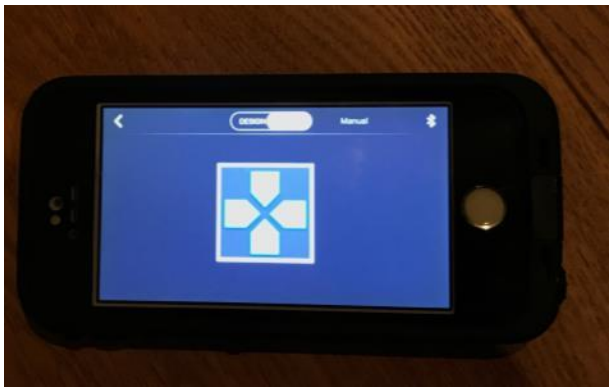


Figure 13 i-Phone code