Stability Relief for the Optically Challenged (S.T.R.O.NG.)

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Abstract— It has been a worldwide problem to have low vision and blindness. The problem has come at zenith when in the whole world, there are 39 million of people are blind and 245 millions have low vision. Even though there has been such a serious problem, there is no proper technology for the people which can become a prop for blind people. We suppose that this paper shall address an alternative to the technologies that already exist and henceforth, they will not need to be dependent on any stick.

Key words: Object Detection, Ultrasonic, Vibrations

I. INTRODUCTION

Major portion of the visually impaired people need assistance on a daily basis, in performing activities as basic as walking. With the help of our proposed system S.T.R.O.N.G. (STability Relief for the optically challeNGed), our vision is to assist such people towards a better life of self-respect and confidence. Our system will be primarily based on object-detection principles for accomplishing this task.

II. EXISTING SYSTEMS

The following are some systems that are currently being used to help visually impaired people:

A. Kinecthesia:

Kinecthesia is a haptic waist-belt designed for blind people. It has particularly used Kinect which is a motion sensing input device by Microsoft for Xbox 360. The Kinect detects objects in the blind user's path and vibrate the motors to warn him or her of the obstacles. Actually the BeagleBoard takes input from the Kinect and outputs which motor to vibrate i.e the left one or the right one to negotiate accordingly.

Fig. 1: Kinecthesia

1) Advantages:

1) Very good accuracy
2) High sensitivity towards motion

2) Disadvantages:

1) The nerves around the waistline due to uncertain presence of fatty acids are not that sensitive to vibrations.
2) Quite costly
3) Bulky outlook of the system

B. Headband Assisted Device:

This is another system proposed to help visually impaired people. It has ultrasonic sensors and vibration motors around the circumference of a headband with the motors vibrating faster, the closer they came to an obstacle.

1) Advantages:

1) Less costly as ultrasonic sensors are used.
2) Less bulky in comparison to Kinecthesia.

2) Disadvantages:

1) Vibrating motors stuckon your skull will drive you insane quickly
2) Most of the times dangerous obstacles are not at head level but the waist level. So, it may happen that sensors will fail to detect those and system will fail.

C. SONAR Walking Stick:

It is the cheapest means used by blind people to facilitate balancing while walking. Even though nowadays these come in different shapes and sizes, it gives the user the feeling of dependency and a little embarrassment.

1) Advantages:

1) Cheap and cost effective.

2) Disadvantages:

1) Bulky and really heavy to carry around.
2) May cause imbalance while holding due to weight on one side.

III. PROPOSED SYSTEM

The proposed system ST.R.O.NG. is a wearable system that translates the distance to anything you aim your hand towards into pressure on your wrist. The closer the object, the greater the pressure. Sweep your hand around and the device conveys to you a tactile image of your surroundings.

A. Initial Approach:

For rangefinders, we had decided to use infrared sensors, but they were confused by sunlight, remote controls, security cameras and absorbent surfaces.

We also looked at lasers as range-finders as they would have been the most accurate, but they were far more expensive.

And in order to make our system available even to the economically backward blind people, we have used two ultrasonic sensors that detect objects up to 10' away, angled apart to take in a broader swath.

The rangefinders input to an Arduino Pro Mini, which controls 2 small servomotors to rotate flexible rubber

extensions into the back of the user's hand. The servos have a split-second response time, which gives the S.T.R.O.N.G. an intuitive feel. Everyone who has worn the device figures it out immediately.

B. Design of the System:

1) Step #1: Assemble The Electronics:

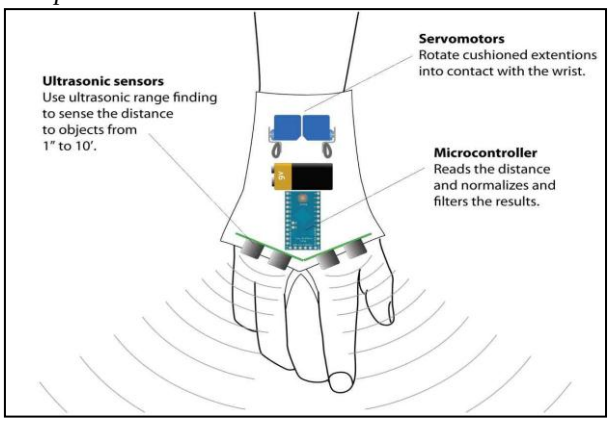

Fig. 2: Design of ST.R.O.NG.

- To carry all the wiring, I made a shield for the Pro Mini using perf board and headers. Start by soldering 12×1 male pin header rows along the sides of the Mini. Cut a piece of board to 9×12 holes and solder two 12×1 female headers so that it will plug on top of the Pro Mini with 2 extra rows along one side for the power switch.
- Solder a 6×1 right-angle header to the top of the Pro Mini, for programming, and two 3×1 right-angle headers to the shield for plugging in the 2 servo cables.
- Follow the diagram and schematic (images 2 and 3) to wire up the shield. Connect the 9V battery (+) to RAW power on the Arduino and the middle (+) servo header pins. Connect battery (–) to Arduino GND through the switch, and directly to sensor and servo grounds. Connect Arduino VCC to sensor power. Finally, connect Arduino digital I/O pins D7 and D8 to the sensor signal (SIG) contacts, and pins D2 and D3 to the servo signal pins.[3]

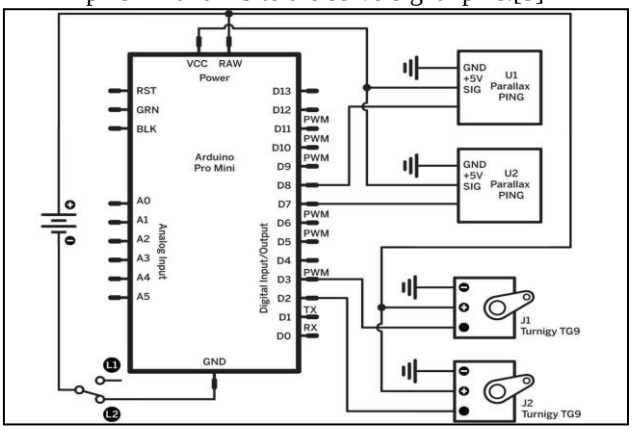

Fig. 3: Schematic Diagram of ST.R.O.NG

2) Step #2: Mount The Sensors And Effectors:

- Melt the ShapeLock in hot water and mold it into a bracket that joins the 2 sensors onto the top end of the shield and angles them apart at about 120°. Make sure not to block the programming header. For extra hold, run small screws through the sensor board mounting holes and into the ShapeLock while it's still soft.
- Join the servomotors back-to-back with more ShapeLock. Cut 2 tabs out of the PET plastic, about 2"×1¼" each. Heat them crossways over the soldering iron without touching it, and bend each into a symmetrical right-angle S-bracket. Drill and mount each bracket to a loop of cut rubber and epoxy the other end to a servo horn. Lay out the 2 assemblies with the battery in between. The mechanism is done.

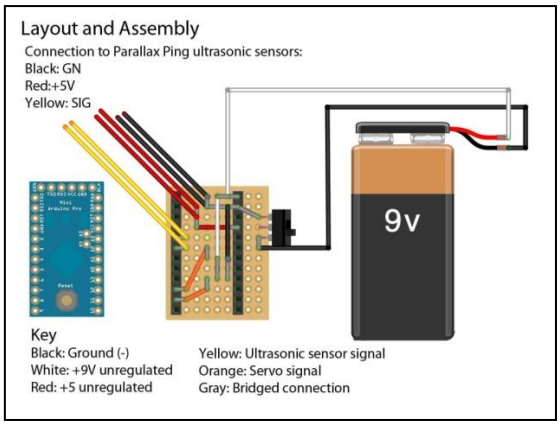

Fig. 4: Layout and Assembly

3) Step #3: Program the Arduino:

- Download and install the Arduino IDE.
- Open the project code in the Arduino IDE. In the Tools → Board menu, choose your model of Arduino, and under Tools → Serial Port select the COM port, the highest number if you see more than one.
- Plug the USB-TTL cable (or USB cable and FTDI Friend) between your computer and the Pro Mini. Click Verify and Upload to compile the code and burn it to the controller chip.

4) Step #4: Make The Gauntlet:

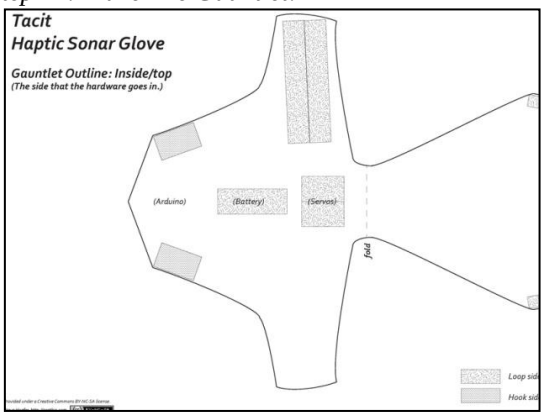

Fig. 5: Blueprint of Gauntlet

- Download the template for the gauntlet and use scissors to cut the shape out of neoprene.
- Cut and sew velcro strips onto the neoprene where indicated, and sew on a loop of bias tape to fit the middle finger in front of where the Arduino sits.
- Use super glue to attach the corresponding Velcro pieces to the electronics and the plastic brackets. The Velcro lets you remove the electronics and

launder the neoprene. Stuff that's near the hand can get dirty surprisingly fast.

- Electronics sewn into wearable material will inevitably flex, but solder joints can't take much bending before they break. So wherever possible, you should loop the wire through holes and use zip ties to give each connection plenty of play.

5) *Advantages:*
   1) The financial cost of ST.R.O.NG. is a major advantage over other guidance devices. It is cost effective as ultrasonic sensors are used in.
   2) It is handy and wearable.
   3) It gives good results in the range of around 10'.
   4) The modules used drastically cut down on the power requirement.
6) *Disadvantage:*
   1) It is not as accurate as it could be if lasers were used as rangefinders.

IV. CONCLUSION

We have tried to suggest a considerably precise, cost-effective and attractive alternative to the existing technologies that assist visually impaired people. This system will be available to economically backward blind people also who can't afford the existing costly systems. As an improvement, we are trying to refine the software, shrink the hardware and use a rechargeable battery with some kind of blind-friendly charging method, either wireless or a magnetically-aligning power plug.

V. FUTURE SCOPE

The current architecture of ST.R.O.NG. can be coupled with an onboard database, since the Arduino Nano has a Flash memory of 32Kb. This database can be used to store commands that can give voice guidance to the blind person, directing him more clearly on his path. The database can also utilize KDD (Knowledge Discovery in Data mining) concepts to suggest new places to the user, based on his previous routes. Apart from helping the blind, this device can also be simulated to be used in near blind scenarios, such as rescue operations caused due to fire. Firemen can thus find their path carefully, in areas covered with high density smoke.

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