**William Grey Walter**

William Grey Walter was born in 1910 in Kansas City was a neurophysiologist in UK and USA. He made significant advancements to the EEG machine which allowed him to make several discoveries in the brain which include theta and delta waves. His research in the late 1940s led him to build some of the first ever autonomous robots [1], considered his most famous work.

His aim was to study the basis of simple reflex actions and investigate further his theory that complex behavior resulting from neural connections [2]. His robots, which he called ‘tortoises’, which he called due to their similarities in shape and appearance of the animals, were named Elmer and Elsie [3]. The robots were able to move towards a light stimulus and thanks to this had the feature of returning to their charging station once they realized they were running low on power.

**Logo**

Logo is a simple educational programming language that was designed in 1967 at Bolt, Beranek and Newman (today known as BBN technologies), a technology lab based in Cambridge, Massachusetts. It introduces kids to the step by step approach to thinking that is necessary when programming. Logo is best remembered for having a turtle as a cursor which appeared in the centre of the screen. Turtle graphics is the construction of shapes and images using vector geometry to utilize relative direction and distance instead of regular Cartesian geometry. Users create shapes and patterns by navigating the turtle, resulting in a line, which traces the route the turtle has taken. Logo also allows users to apply a ‘repeat’ command which meant storing a set of commands to execute, effectively creating a very simple program. There have been several developments of Logo, the majority of these are still only in two dimensions. One such program for example is LibreLogo [4], which is written in Python and uses turtle graphics to help teach programming and graphic design. An example of a development that encompasses three dimensions is the Elica interpreter [5]. Lhogho [6], another version of the Logo program, which was in fact built by the same author of Elica. Logo has been used to control robots and has been interfaced with Lego products but was not selected as the program of choice by Lego when they came out with their Lego Mindstorms range; a combination of Lego and a CPU that allowed children to customize program robots.

**Micromouse**

Micromouse is a competition that was introduced in the late 1970s by IEEE Spectrum magazine. It involves teams designing robots to compete against one another in a race to see which robot can get to the centre of a maze, made up of an 8ft square consisting of 16x16 cells, in the fastest time. There are a number of rules to the competition, but the main theme is that the robots are autonomous. Once the maze is unveiled, each mouse is given a pre-specified amount of time or number of runs, depending on the competition organizers to learn as much as possible about the maze [7]. In 1977, the inaugural competition was won by a high-speed dumb wall follower. 1980 produced the first ever micromouse to find the centre of the maze and know it had done so. Despite travelling at the glacial pace of 0.2m/s, the achievement was groundbreaking nonetheless. Only a couple of years later in 1982, Alan Dibley won with a best time of 1min 13s [8]. The current world record is held by Ng Beng Kiat, a lecturer at Ngee Ann Polytechnic, Singapore, at 3.921s.

**Materials**

An important aspect to consider when deciding on a material to choose for the body and base of the robot is the penetration into the sand. A denser material will cause the robot to sink more, but with lighter materials being used, either strength, stability or price will have to be compromised. However, if modifications are made to the design of the wheels and the contact area with the sand is considered in relation to this, it may allow more freedom when deciding what materials the components of the robot should be made up of. Researchers at the Georgia Institute of Technology have been able to vary the strength of the supporting ground by using varying air flow from beneath [9]. This has allowed them to vary the stiffness of the sand and observe how the performance of a robot on these surfaces, named Sandbot, varies with that of five animals, all of which performed better than the robot. The robot should be made to be water resistant. Being a machine to be used at the beach, contact with water at some point is inevitable, and water coming into contact with the electrics in place would unsurprisingly dramatically reduce the lifespan and reliability of the machine. What is also worth considering is the damage that can be caused to be robot by the sand. The machine is likely to come into contact with a substantial amount of sand, and depending on the digging mechanism selected, some of this sand can be expected to have been thrown through the air. Sand is silica, which is very abrasive and will definitely scratch the outer surface. If this abrasion occurs around the more sensitive areas of the machine, it could cause extensive damage. Baz Brown, an Australian from the Gold Coast, Australia has invented a range of beach products that are waterproof and sandproof [10]. This is thanks to the use of a smooth nylon material that allows sand to slide off easily, combined with an inner waterproof lining. It is worth considering the use of this technology to protect the most precious parts of the robot.

1. <http://cyberneticzoo.com/category/cyberneticanimals/grey-walter-cyberneticanimals/>
2. <http://www.extremenxt.com/walter.htm>
3. <http://www.cerebromente.org.br/n09/historia/greywalter_i.htm>
4. <http://librelogo.org/quick-start/>
5. <http://www.elica.net/about.html>
6. <http://lhogho.sourceforge.net/>
7. <http://www.ntf.or.jp/mouse/micromouse2010/ruleclassic-EN.html>
8. <http://www.micromouseonline.com/micromouse-book/history/>
9. <http://www.futurity.org/lizards-robots-movement-1023252/>
10. http://sandusa.net/the-sandusa-story/