

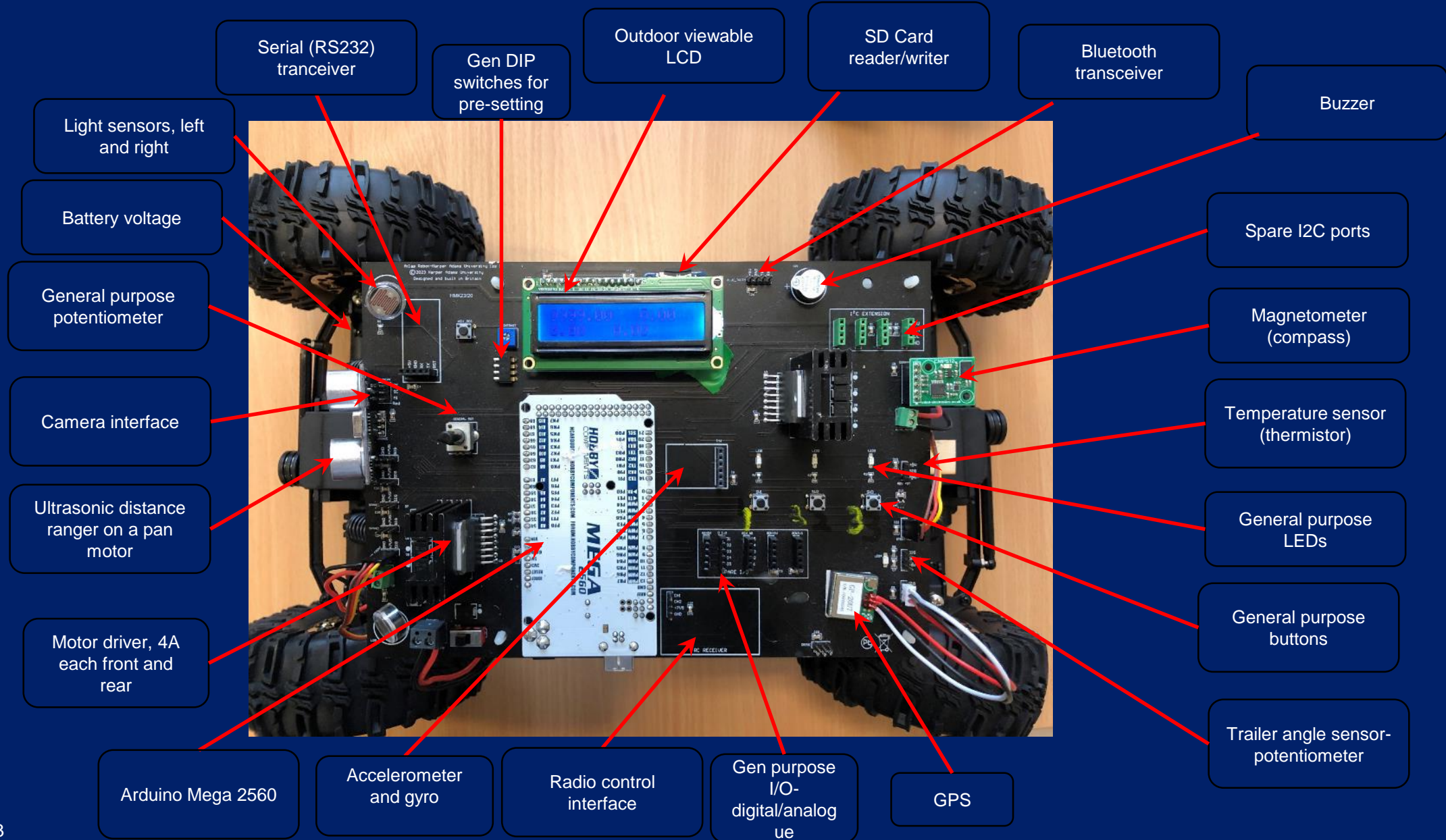
# Teaching Agricultural Robotics to Developing Countries

# Where it all began...

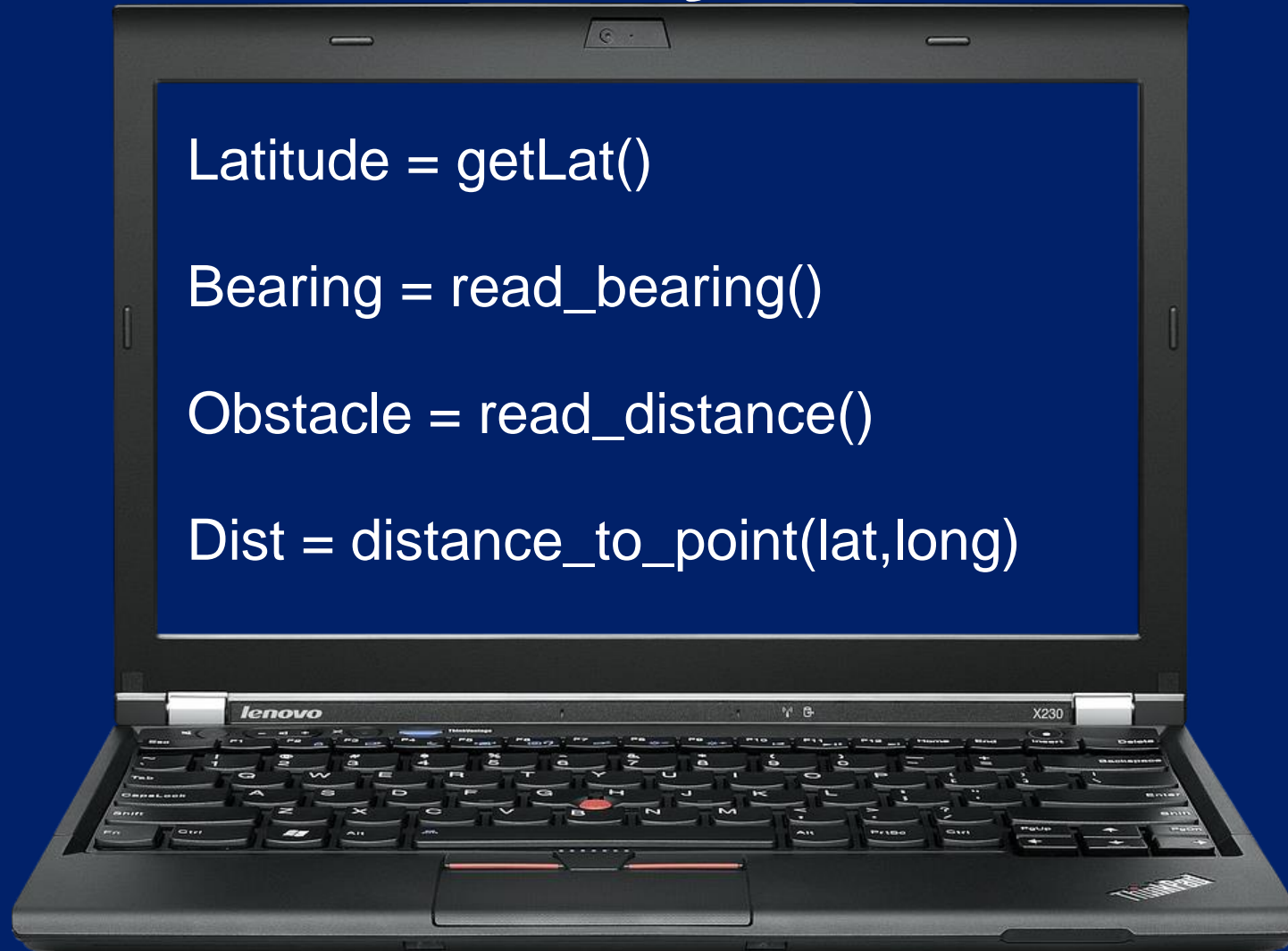
- Developed for summer schools since 2015
- Battery powered – on in an instant !
- Has a bespoke designed PCB
  - Designed by me
  - Manufactured and built in the UK
  - Costs approx. £340 (PCB-£120, sensors-£100, chassis £120)
- Has libraries to access the hardware- Written mostly by me (and some others)
- Is based on an Arduino, the world's most popular controller ([www.arduino.cc](http://www.arduino.cc))
- Created to teach all the essential of robotics
  - Behaviour, state, navigation, communication, kinematics
- All info is on Github







# So what is a Library ?



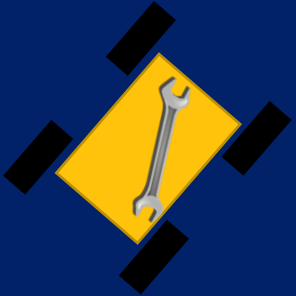
# GPS and compass, control Steer and Speed



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# Add 'via' point to avoid trees

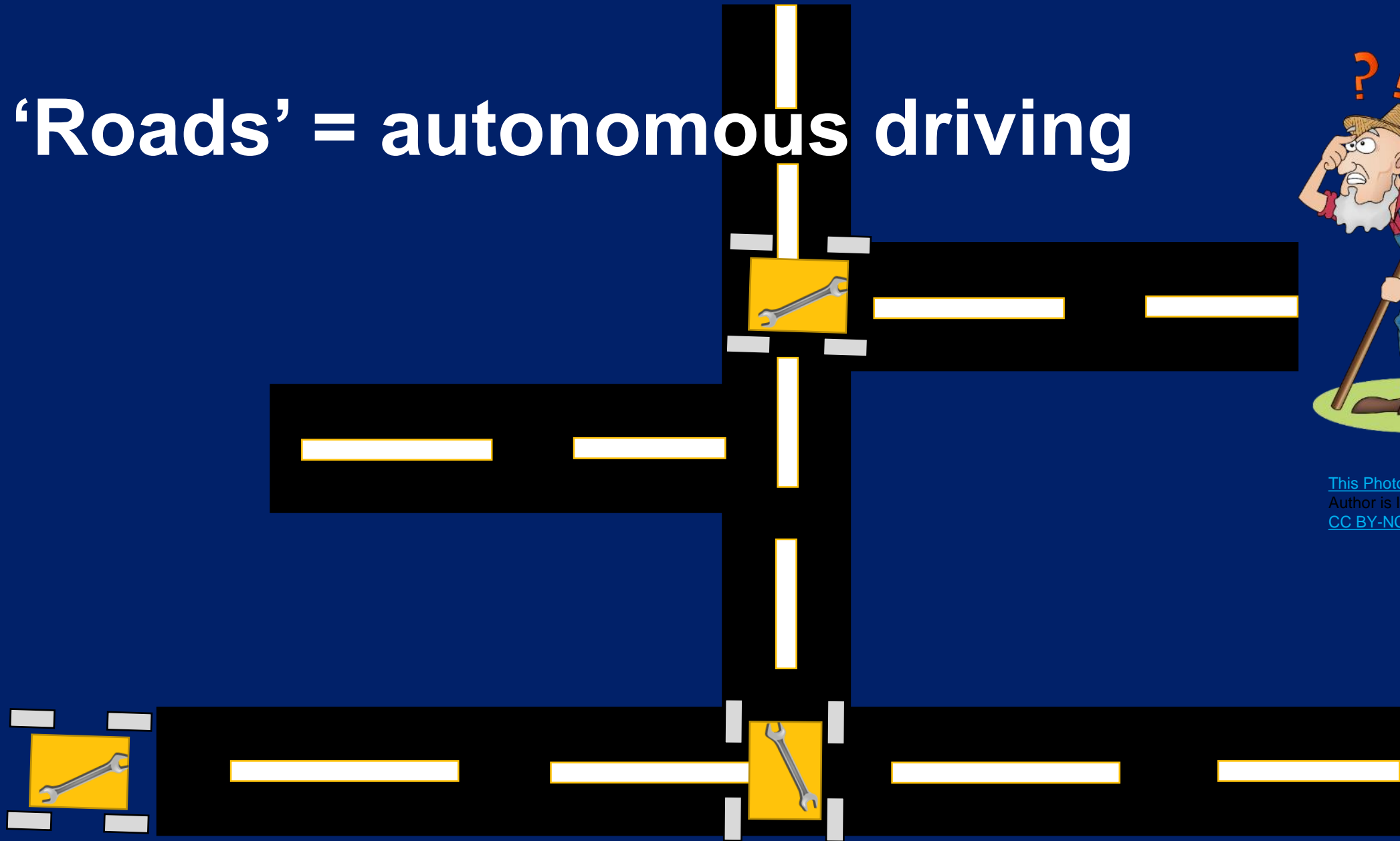


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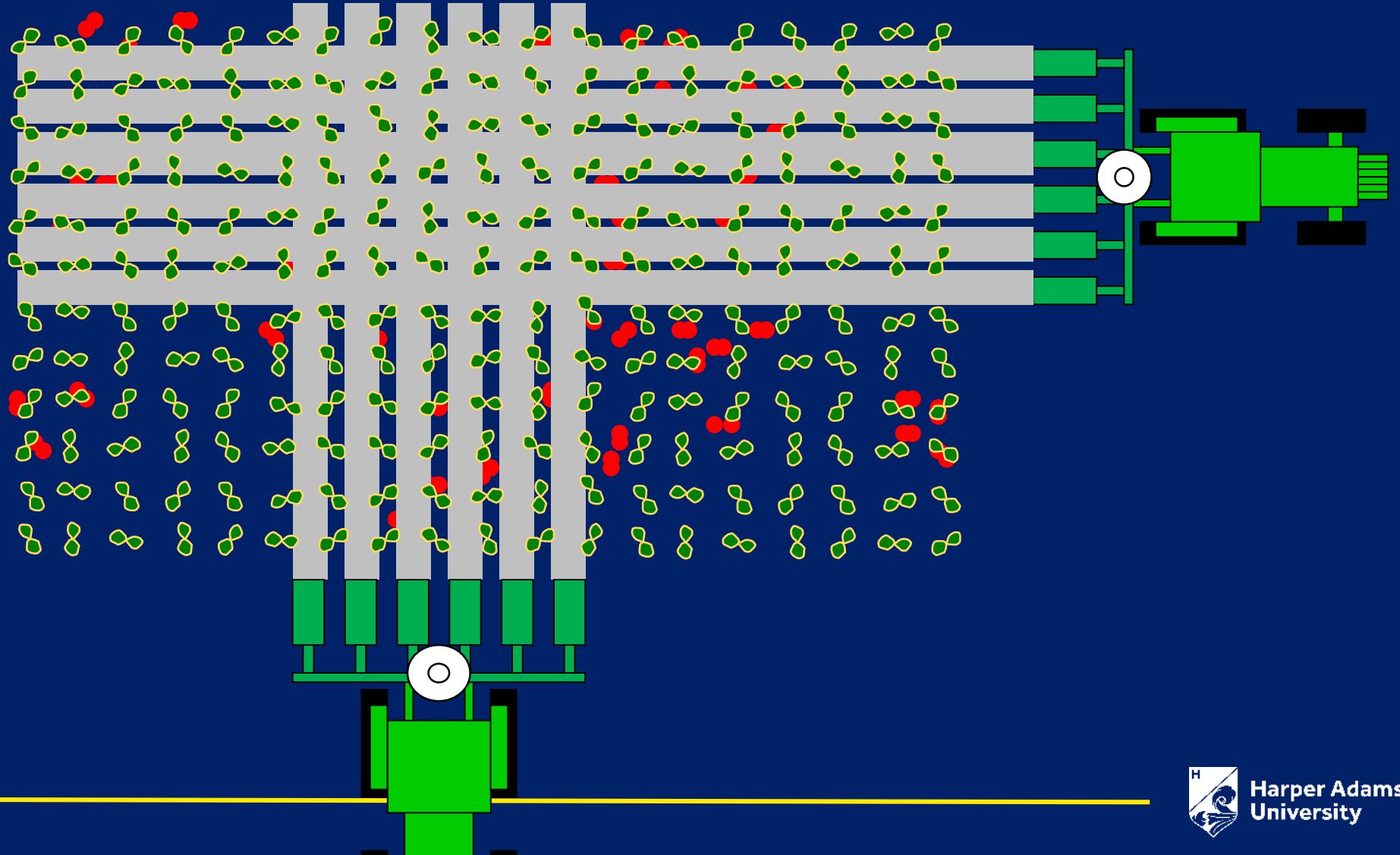
# 'Roads' = autonomous driving



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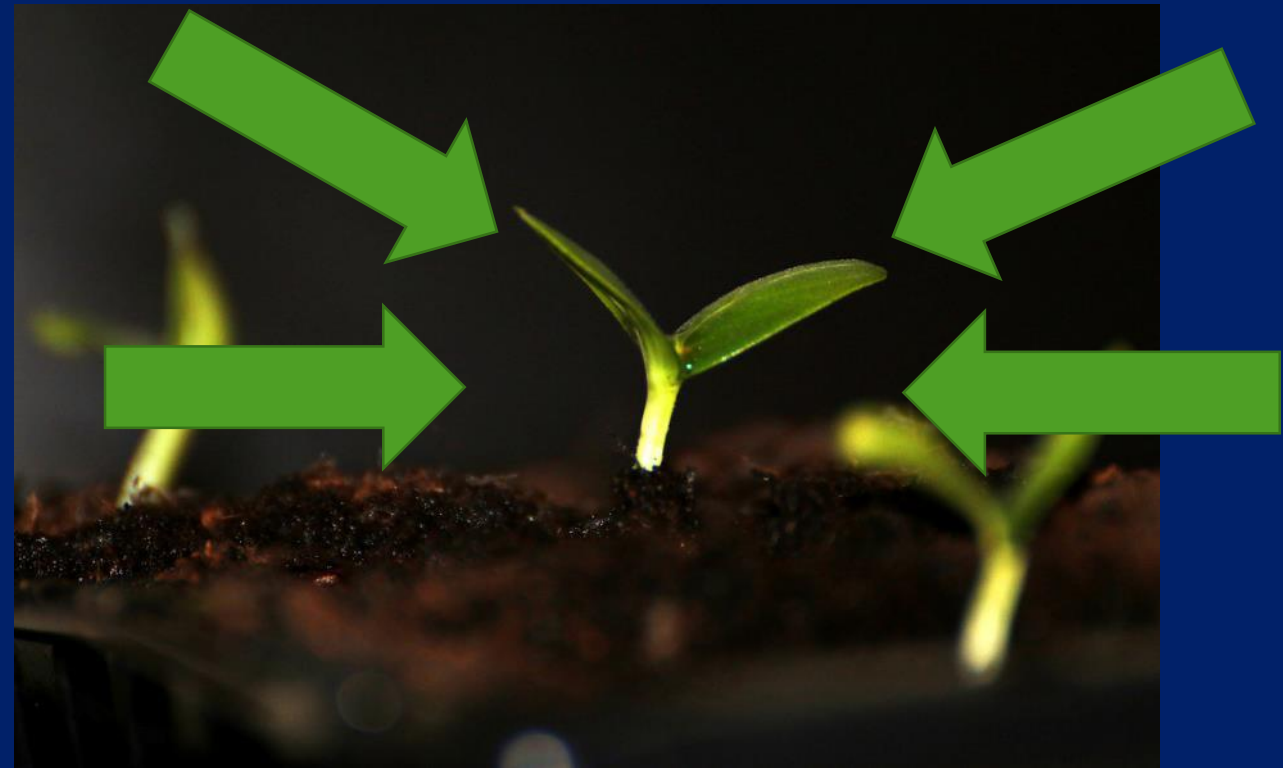
# Simplify farming into Input / Output





# Individual plant care

- Can the machine only spray the crop where it is needed – Spot Spraying
- Its not about replacing the driver but having a system with the patience to move through a field slowly..



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# When spraying a driver will go home after the wind gets up

Can we build a machine that can wait for the wind to die down and continue?



# There's a lot to robot engineering !

Inputs-sensors  
Outputs-motors  
IF logic...  
Continuous control:  $out = K \times input$   
Error value minimisation

Variables  
Loops  
Advanced sensing: velocity,  
edge detection, pulse  
counting  
Interrupts  
Timers  
PID control

Robot Operat  
RTK GPS  
PC Control  
App control  
Tele-operation

ROBOT  
ENGINEERING

Sensor calib  
Filtering data  
Display  
Transmissio

## Lessons

	Complexity→			
Lesson number	a	b	c	d
1	Robot Chassis			
2	Buttons and Logic	Continuous Control		
3	Variables, functions counting and loops	Edge counting, Encoders and interrupts	States for latching	Speed and PID
4	Display	Timers and multitasking		
5	Reading and filtering sensors	Filter types and sampling, Kalman etc		
6	GPS & compass	Bearing to point	Bearing calibration	Vehicle kinematics
7	Navigation to point	X track error		
8	Advanced navigation	Some crop row tracking algorithms	Straight line fitting	
9	States	Behaviours		
10	Comms			
11	Vision			
12	PC integration	ROS		

# The Living Lab

Engineer,  
Programmer




Farmer,  
agronomist



Robotics is a practical subject. Hands on - feel engineering, Simulation will always work!  
Agricultural terrain! Noisy sensor signals!



# Fun and simple tasks-increase complexity

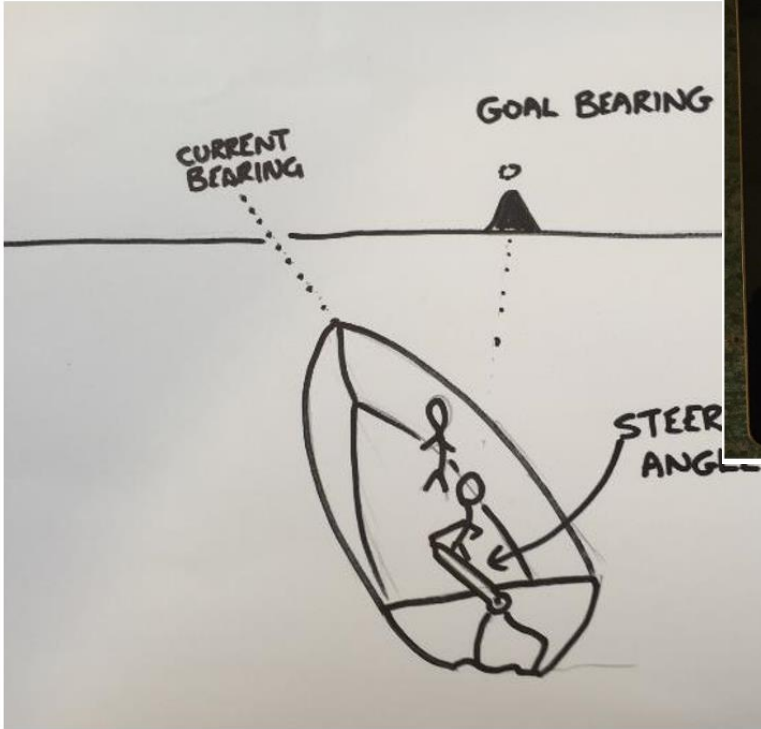


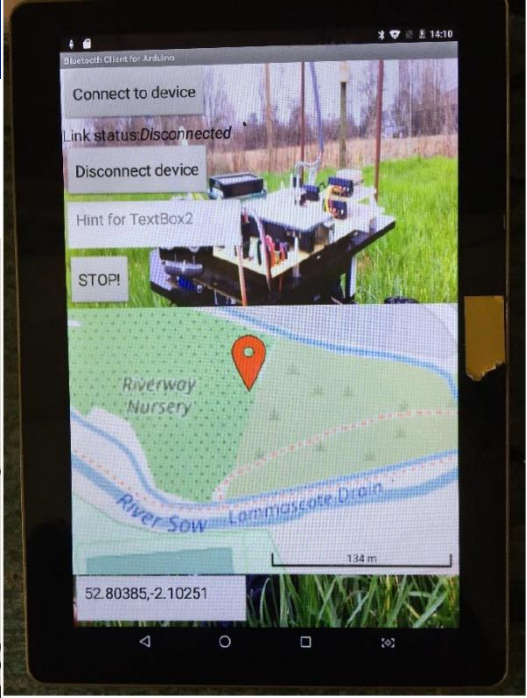
Rob  
Tas

## Wall following

## Navigation

1. BUZZER:-change the commands:
2. Change the delay
3. Open the Example upload and run it.
4. Now modify your k





# Papers and some recognition

<http://harper.ac.uk/8h41>



## ATLAS Robot

### Ag

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**Abstract** — Robotics is heralded as the solution to precision farming, the application of the burdening food short quite intimidating to some students to handle for professors, particular agriculture can be rather large and this research is to develop an interactive used to learn the fundamentals of navigation as a springboard to the I. This paper discusses the results of ATLAS due to its use of GPS navigation that the robot can accomplish were in a wall surface, and navigating to a waypoints. Some real projects developed the ATLAS robot in their studies. Furthermore, this paper can be used in institutions as an alternative teaching robotics subject.

**Keywords**—Autonomous robot, C, PWM signal, Arduino, Precision Farming

#### I. INTRODUCTION

Robots are becoming essential in our daily lives. In becoming popular because of sustainability and shortage in farmlands, more research is being conducted.



“...an opportunity to pull together, share ideas and problems which engineering is full of, and to find ways in solving”

## Development of a Microcontroller based Robot and its use in Teaching Control and Navigation

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**Abstract**— This paper sets out a framework for the essential elements necessary for the implementation of outdoor autonomous mobile robots along with example algorithms. Robotics is a multi-disciplinary subject requiring a hands-on approach when developing machines to interact in the real world. Courses in robotics exist which either include simulated robots, access to robots in a laboratory, or remote access to robots in a controlled indoor environment. This study presents a teaching system based on a robust robot with a focus on navigation and communications in an uncontrolled outdoor agricultural environment. An all-terrain robot teaching platform was developed with the necessary hardware, libraries, and teaching material consisting of lectures and practical fieldwork. The course is tested on a variety of student levels and

experience. Problem solving games such as ‘Bridge Builder’ [5] allow the student to develop at their own pace, see the results immediately and gain a ‘feel’ for the right answers. This intuition step is a sort of self-checking and sanity check on their calculations.

A majority of the applications in control and robotics are to develop systems that act in the real world, and the teaching of control and robotics engineering topics are well received when it is related to the physical environment. Computer code can be brought to life when it interacts with the environment, and this is an infinitely changing testbed for developing code. An online method for teaching mobile robots was developed where the students can remotely access the robot in a



# TAFE and rem



**Engineering Academy**  
**ROBOTICS**



For Middle management and Engineers of COE and R&D

**LEARNING OUTCOME**

- Understand the existing and upcoming technologies in the field of Agri-robots and its architecture
- Understanding principle of design, UI technology and safety requirement

**About the Program**

This program is designed to create awareness and build capability on robotics that will help the organization on the scope of building field Ag-bots & autonomous vehicles

PROGRAM DELIVERY	PROGRAM CAPSULES
<p>Blended Learning, to put learning to practice— Holistic Learner Experience!</p> <div style="display: flex; align-items: center;">  <div> <p><b>Self-paced Learning</b> Micro content Learn at your own pace.</p> </div> </div> <div style="display: flex; align-items: center;">  <div> <p><b>Social Learning.</b> Collaborate with peers and facilitators to reflect and learn together.</p> </div> </div> <div style="display: flex; align-items: center;">  <div> <p><b>Expert Knowledge Sharing.</b> Top-up your learning with the wisdom of experts.</p> </div> </div> <div style="display: flex; align-items: center;">  <div> <p><b>Virtual Instructor Led Workshops.</b> Engage in Live session . Learn through case-studies and interactions.</p> </div> </div> <div style="display: flex; align-items: center;">  <div> <p><b>Coaching and Mentoring.</b> Get the guidance and directions to complete your learning assignments or projects</p> </div> </div>	<p><b>*Capsule 1 : Robotics - Introduction</b></p> <p><u>Modules covered</u></p> <ul style="list-style-type: none"> <li>Introduction of robotics, automation &amp; challenges</li> <li>Hard/soft automation</li> <li>Outline of a computer program</li> <li>Connectivity protocols</li> </ul> <p><b>Capsule 2 : Robotics - Basics</b></p> <p><b>Capsule 3 : Robotics - Intermediate</b></p>
IMPORTANT DATES	
<p>Program Launch Date : 20th Oct 2021 - 3 PM IST</p> <p>Capsule 1 Start Date : 27th Oct 2021</p> <p><small>*Identified learners who complete the introduction capsule shall undergo the basic and intermediate capsules</small></p>	





**SLC Engineering Academy | Robotics | Agribot Demonstration**





Harper Adams University

Contact: [slcademies@tafe.com](mailto:slcademies@tafe.com)



# github.com/swane/atlas

