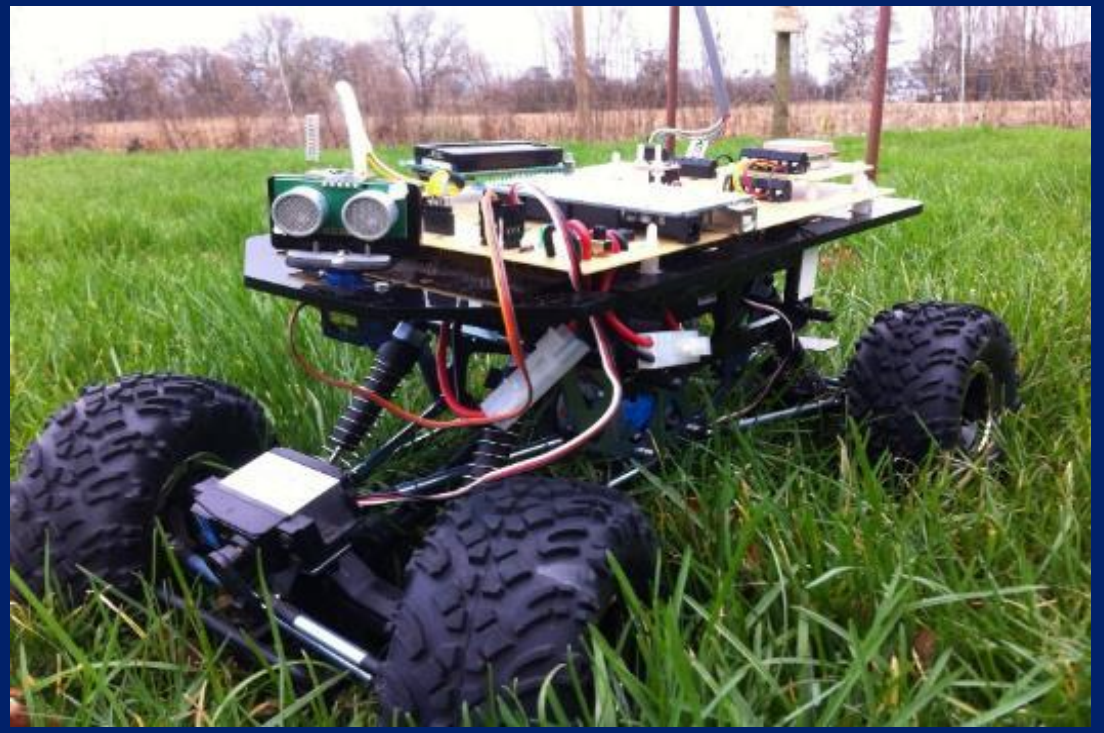
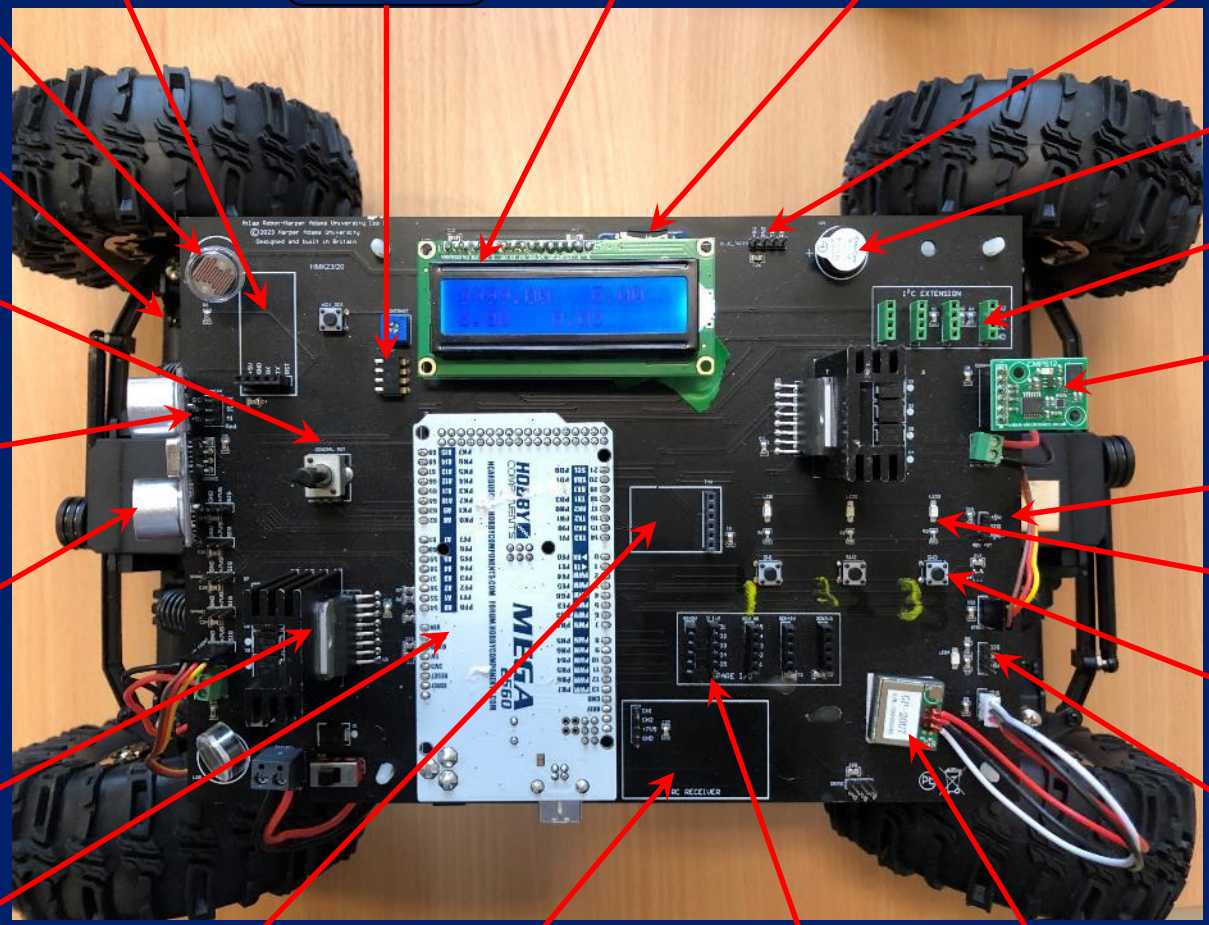


Teaching Agricultural Robotics to Developing Countries

Harper Adams University

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)
- Created to teach all the essential of robotics
  - Behaviour, state, navigation, communication, kinematics
- All info is on Github



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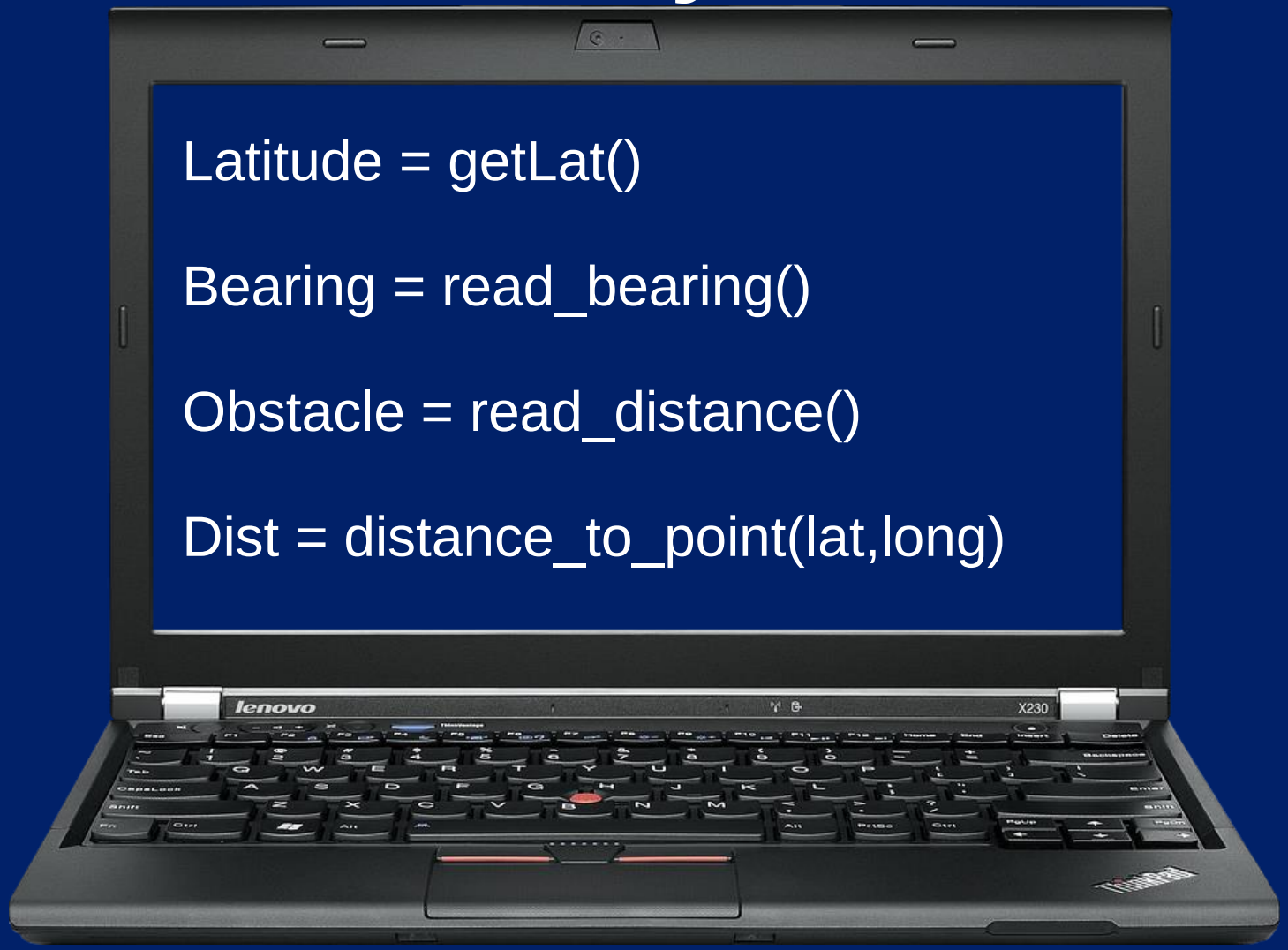
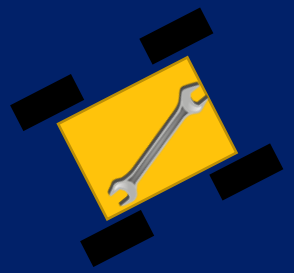
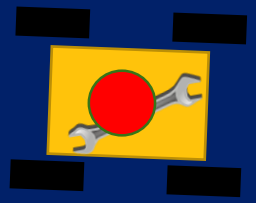
So what is a Library ?



GPS and compass, control Steer and Speed

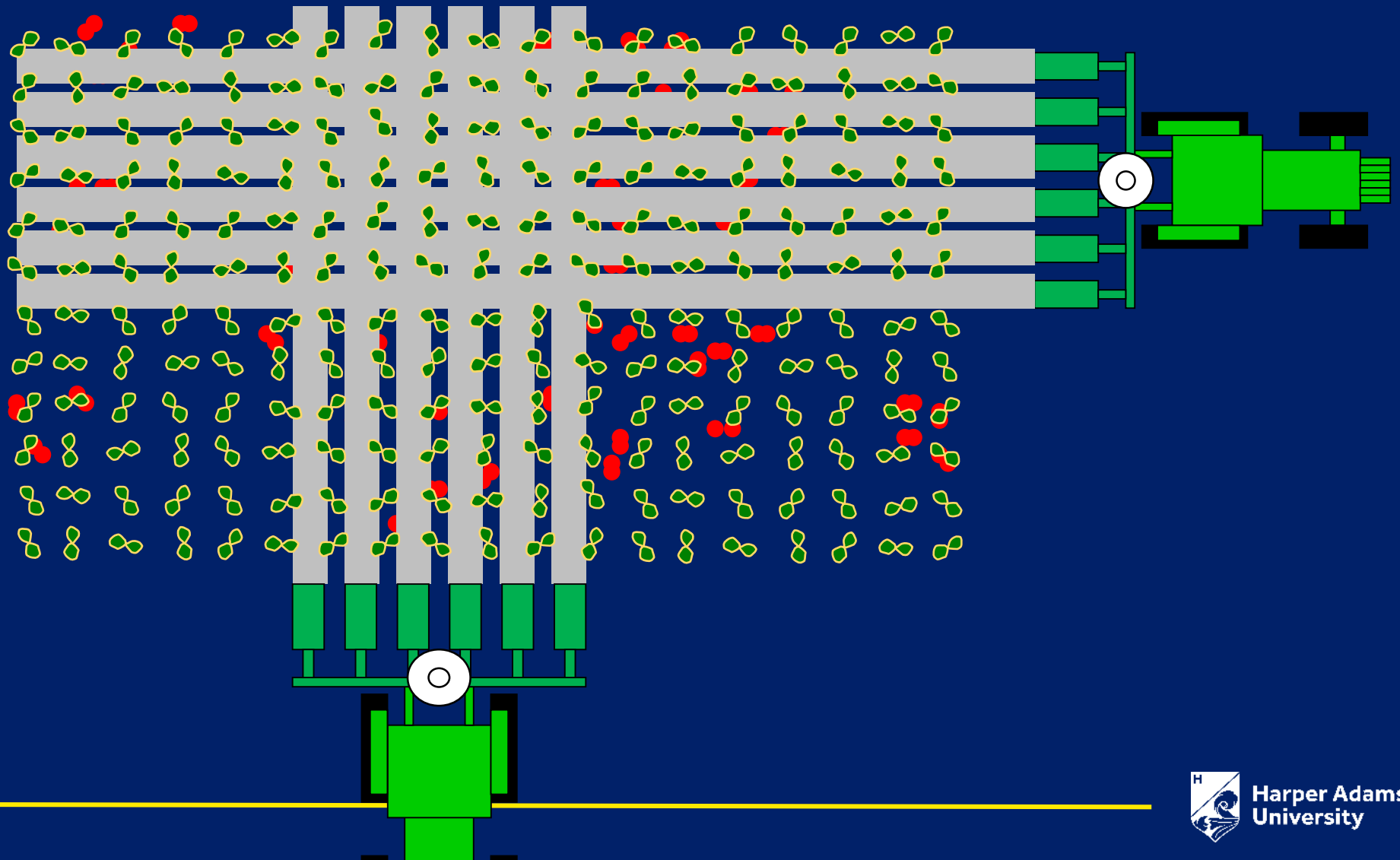


Add ‘via’ point to avoid trees



‘Roads’ = autonomous driving

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..

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 !

Robot Operati
RTK GPS
PC Control
App control
Tele-operation

Inputs-sensors
Outputs-motors
IF logic…
Continuous control: out=K x input
Error value minimisation

ROBOT ENGINEERI

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

Sensor calib
Filtering dat
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		

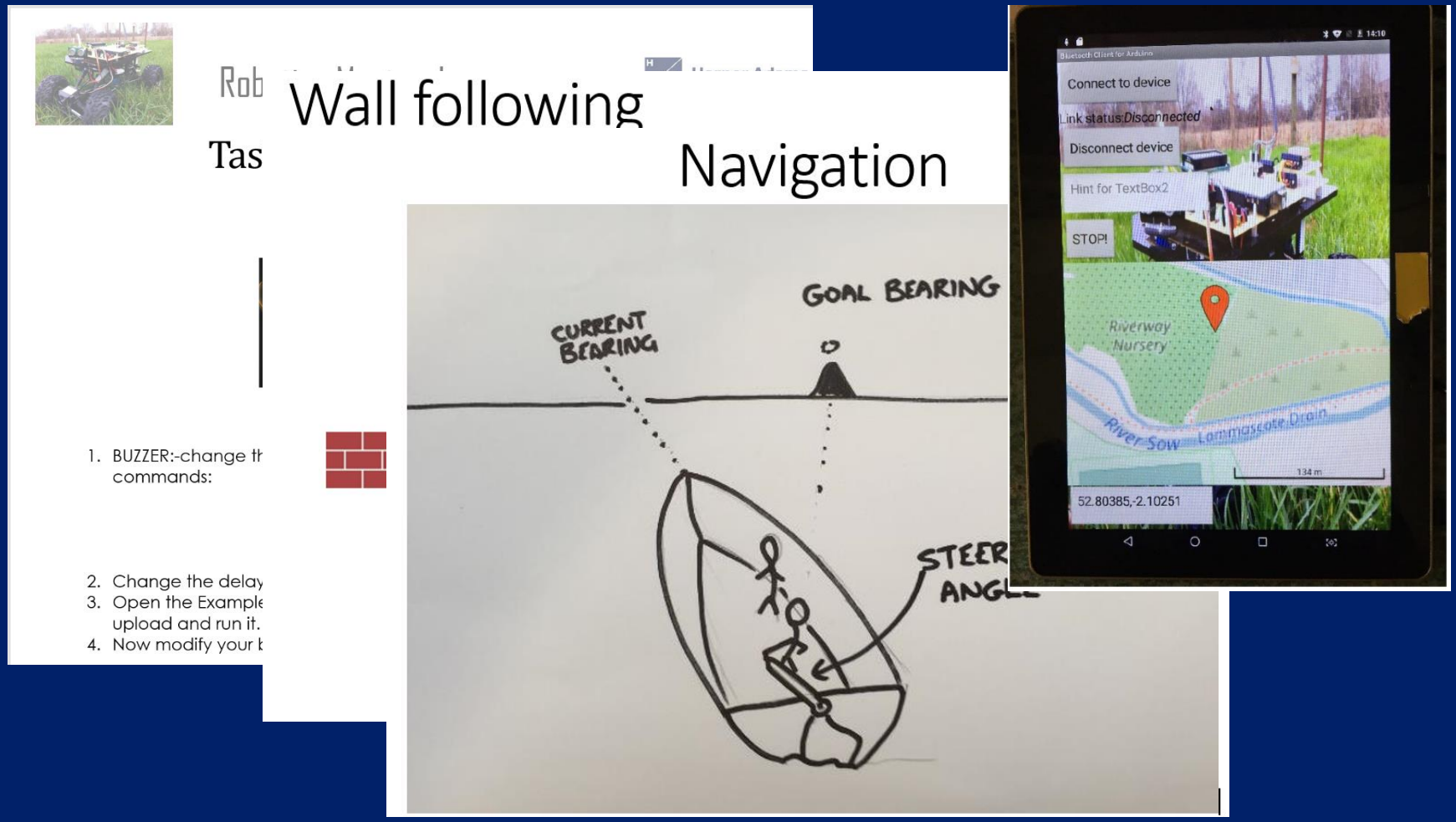
The Living Lab

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



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Papers and some recognition

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

ATLAS Robo
Ag

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Abstract **— Robotics is heralde precision farming, the application solution 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 interac be used to learn the fundamentals of navigation as a springboard to the This paper discusses the results ATLAS due to its use of GPS navi that the robot can accomplish were a wall surface, and navigating to a waypoints. Some real projects develo the ATLAS robot in their stu Furthermore, this paper can be use institutions as an alternative teachi robotics subject.**

Keywords—Autonomous robot, PWM signal, Arduino, Precision Farm

I. INTRODUCT

Robots are becoming essential problems in our daily lives. In becoming popular because of sustainability and shortage in far

..an opportuni
pull together, s
ideas and prob
which enginee
is full of, and to
ways in solving

In August this year, I had an amazing opportunity to visit your wonderful country. Whilst this was a business visit (with a bit of island hopping playtime

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

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[1] ***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 field-work. 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

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github.com/swane/atlas

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