

Project ideas for G54MRT

For G54MRT coursework you need to design and build a prototype of some kind that:

- Uses at least two sources of sensor data
- The prototype combines the sensor data and interprets it in some way

The key thing to remember when prototyping and considering project ideas for prototyping is that **you should not be concerned with the form factor of the prototype**. For example, you should not worry about whether it is practically feasible to attach a Raspberry Pi to an object so as to instrument / augment it in some way, and instead presume that a productised version of your prototype could be technically feasible (i.e., miniaturised, sufficiently cheap, etc.). Equally it may be the case that some fundamental connectivity required for your device is missing, e.g., 3/4G mobile network connectivity. In limited cases you can assume that demonstrating on wired and / or wireless networks is sufficient.

The focus of the coursework is on proposing an innovative design and technically constructing some substantive element of that design proposal.

There are three broad possibilities for the prototype you design (although we are open to alternative proposals if you wish). These are:

1. A physically stationary prototype system that performs environmental sensing
2. A mobile system prototype where the prototype is intended to move around in some way
3. A combination of the above (e.g., a prototype that has a mobile component that interacts with / uses fixed environmental sensors as well)

1. Fixed sensing (i.e., stationary sensing device(s))

This first option is primarily about interpreting data that is being collected from a particular place or set of places in which sensors are installed. A simple real world example is the Nest thermostat which—based on several basic sensors: temperature, motion and humidity—decides the best temperature for your home based on presence, weather data etc.

Example 1: Augmenting a fixed object

The idea here is that we are giving something that is spatially fixed some extra functionality by adding sensors.

Example: A shared office based coffee machine that can make many different types of coffee. How could you use various sensors to improve the user experience? Consider:

- Recognising who is using the machine and dispensing their favourite coffee automatically
- Keeping count of how many cups a person has each day and when they have them
- Emailing the servicing contract holder when the machine requires maintenance
- Recording who does maintenance for the machine (e.g., user-led cleaning) and who ignores these tasks

Example 2: Augmenting an activity / space

For this example, we are adding sensor functionality to specific spaces in order to sense certain kinds of designated activities (note that Example 1 is similar to this in some ways). In the example below this is coupled with some notion of 'persuasive' computing, i.e., we then provide feedback to the user on those activities to influence their actions in some way.

Example: A 'hygiene alarm'. We want to encourage people to wash their hands after using the toilet by alarming them if they do not. There are also implications for this being potentially embarrassing and uncomfortable for the user. Think about how we might sense:

- When someone is in the bathroom and has used the toilet
- Have the taps been switched on?
- Has the person actually washed their hands correctly?
- What happens if they leave the tap running and exit the bathroom?
- How might we alert the person in a discreet way?

Example 3: Door Counter

Count how many people are going through a door. This seems really easy and can be done in many ways. But in fact it is quite hard:

- You could for example detect how often a door is opened using a switch (but what if two people go through the door)
- You could use ultrasonic sensors or infrared PIR sensors to detect motion around the door (but what happens with multiple people, what happens if someone walks near the door then walks away).
- Could you use sound sensing?
- Accelerometers on the door? Does a door open differently if there are two people rather than one?
- Can you sense which direction people are going in?

Example 4: Table Piano / Table Drums

Sense body movement near a table in order to turn it into a piano or drum pads. Essentially you need to sense touching or hitting the table, and position of that touch. This is hard because:

- How do you reliably detect when a hand hits the table?
- How do you detect position?
- What if another hand is between the touching hand and the sensors?
- What if someone touches with two hands at once?

2. Mobile sensing

The second option is to build a device that prototypes a sensor platform that is mobile in some way. At its simplest level this might involve using the Raspberry Pi as a way to add more advanced sensing to some existing mobile device (e.g., a phone or tablet). Alternatively you can use the Raspberry Pi as a way to prototype some other device which involves mobility.

Example 1: Advanced sensing for mobile phones

What could you do if a mobile device had extra sensors?

- Mobile devices have a bunch of sensors in already (accelerometer, gyroscope, compass etc.)
- There is a recent trend to add sensors to mobiles and wearable devices, such as barometric pressure (to increase altitude accuracy of GPS), heart rate sensing for sports etc.
- If you added some new sensors to a phone, what could this do?
- Remember such a prototype does not have to be truly mobile or use teeny tiny form factor, look at https://www.youtube.com/watch?v=HN_F-coZqt8 for an example of someone prototyping a mobile device with 3d depth camera on it, by strapping a Microsoft Kinect to the device.

Examples:

- If a mobile phone had ultrasound sensors on (some or all of the) sides, what might that be useful for?
- Can temperature tell you something about the context of a device in combination with the existing built in sensors.

Example 2: Sports and fitness devices

Wearable sports and fitness devices are increasingly popular (e.g., Fitbit, Nike+ devices, etc.). There are a range of possible devices that could be prototyped to support physical activities of some kind.

- Multiple networked devices to detect position at various points on a lap course.
- Finish line timing, lap counting.
- Sensor and NFC tag based geo-cache box, that will only unlock in certain conditions.
- Using sensors to detect nuances of physical action in sport (e.g. detecting the quality of a golf swing).

Example 3: Augmenting a 'thing' / non-fixed object

In this example we might want to prototype a device that would be attached to an object that moves around space in some way. This would be done so as to 'augment' the object and / or instrument it in some way. Examples:

- Package / parcel tracking. A device that attaches to the package or is embedded within it in some way could be prototyped so as to give additional information about its progress, how it has been handled, and so on.
- Augmented bike frame. A device that performs a set of useful tasks for the cyclist e.g., behaving as an alarm as well as a trip tracker (some cross-over with Example 2 above).
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