

Physical Tracking Using Touchscreen Technology



B.Sc. (Honours) in Industrial Physics
Department of Physical Sciences

Student Name: Alex Finn

Supervisors Name: Dr Anthony Grant



Project Background

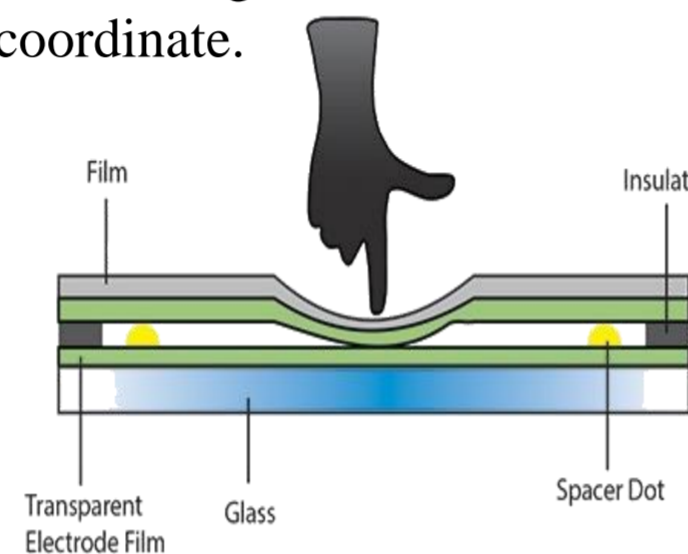
Computer Vision for Object Tracking

With the rapid growth in the performance and potential of computer vision since the turn of the century, object detection and tracking systems have become increasingly sophisticated. However, these systems usually rely on extremely complex tracking algorithms and expensive, high-tech cameras, which are somewhat of a barrier to the technology being implemented on a broader societal level.

This project aims to use resistive touchscreen technology to obtain similarly accurate 2D object coordinates for real-time tracking. The technology could have potential applications in industrial settings, as well as public-facing areas such as interactive glass in museum displays.

Resistive Touchscreen Technology

As opposed to capacitive touchscreens which are used in phones, resistive panels are favoured in industry where durability is vital. It is a pressure sensitive display composed of a flexible top layer above a rigid bottom layer. When the user presses the screen, the top layer touches the bottom, closing the circuit and the resistive signal is converted to a voltage value which has a unique 2D coordinate.



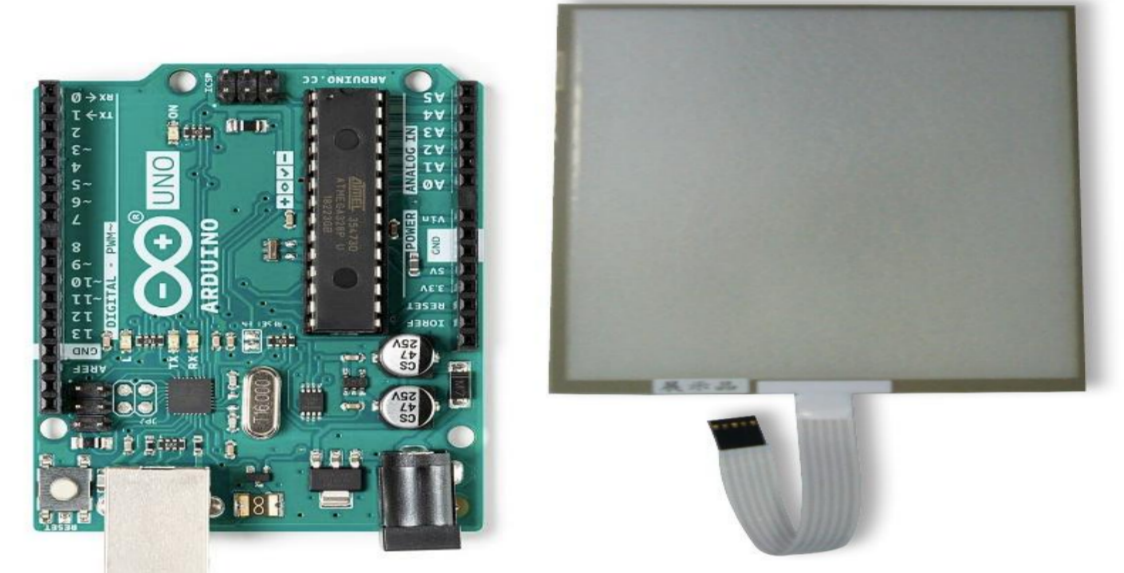
4-Wire vs. 5-Wire Screens

For the purpose of the project, either the 4-Wire or 5-Wire variations of the resistive touchscreen would have been acceptable. However, with the view to implementing the technology on a broader scale, the 5-Wire was chosen.

The 4-Wire variation is cheaper on average and offers increased linearity at the expense of less durability. The durability was a key factor in the use of the 5-Wire screen, since the potential uses of the technology for object tracking would be in an industrial setting. The 4-Wire variation used the flexible top layer to detect a voltage for one of the axes (usually Y). Over time, miniature cracks appear on the panel, causing a drop in linearity for that axis. The 5-Wire did not suffer from the same issue so was deemed a more suitable choice.

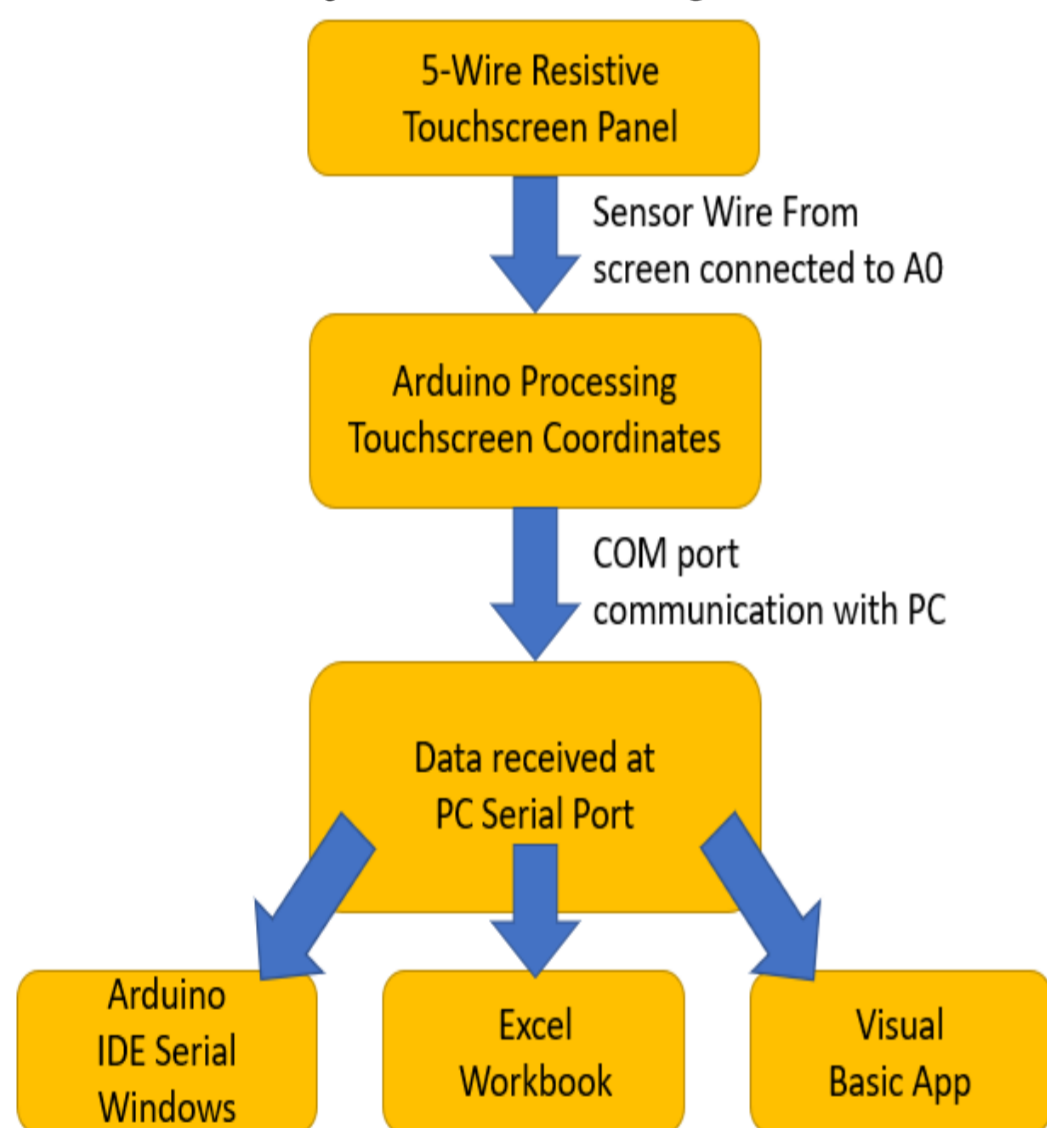
Arduino Microcontroller

The Arduino microcontroller is an open source board primarily used for the design and operation of programmable electronics. For the purpose of this project, the Arduino will have two responsibilities: to supply the resistive touchscreen with a 5V supply and to read the 2D coordinates from the screen and pass them to the Visual Basic application via COM communication with the PC.



Software Design and Testing

Layout of Project

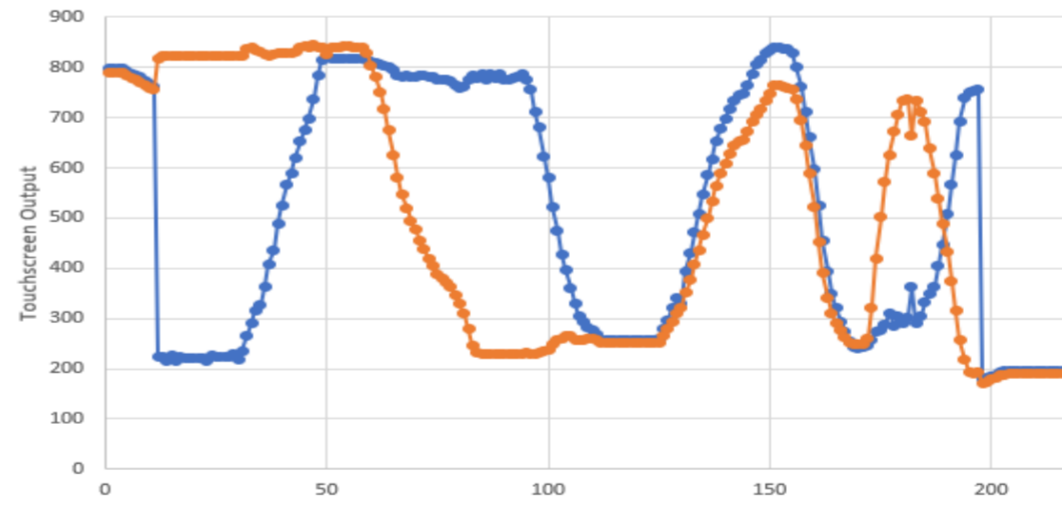


Arduino IDE Program

The Arduino IDE was the first program used to process the data from the resistive panel. Since there was only one wire coming from the sensor layer of the screen, the data for both X & Y axes of the screen was sent to A0 on the Arduino. Time-Division Multiplexing (TDM) was used to alternate which corners of the touchscreen the Arduino were powered. To record the X coordinate, the left corner pins were set low and the right corner pins high, so the voltage in the X gradient was detected and stored by the Arduino. For the Y gradient, the top pins were set high and the bottom pins and the Y gradient voltage was stored.

Excel Data Streamer

Due to the limitations of the Arduino IDE, Excel was used to allow the user to save the data. The Data Streamer add-in was used to take the COM port data and plot it on the Excel spreadsheet and graph in real time. The record function allowed the user to save the data to an external spreadsheet, which was a significant upgrade from the Arduino IDE.



Visual Basic Application

The VB application was the control centre for the entire project. It allowed the user to start and stop collecting data at will and also gave the user the option to clear the data or save it to a .csv file. The data was displayed clearly both numerically and graphically to the user. As such, it was a combination of the Arduino and Excel software, presented in a user-friendly manner with a high level of control afforded to the user. The COM port of the PC was accessed via the serial port module and the control of this component was handled by a timer. Every time the timer "ticked", the data from the COM port was read, stored and plotted in (x,y) format. The graph to the left shows the coordinates over time.

Work Completed and Future Applications

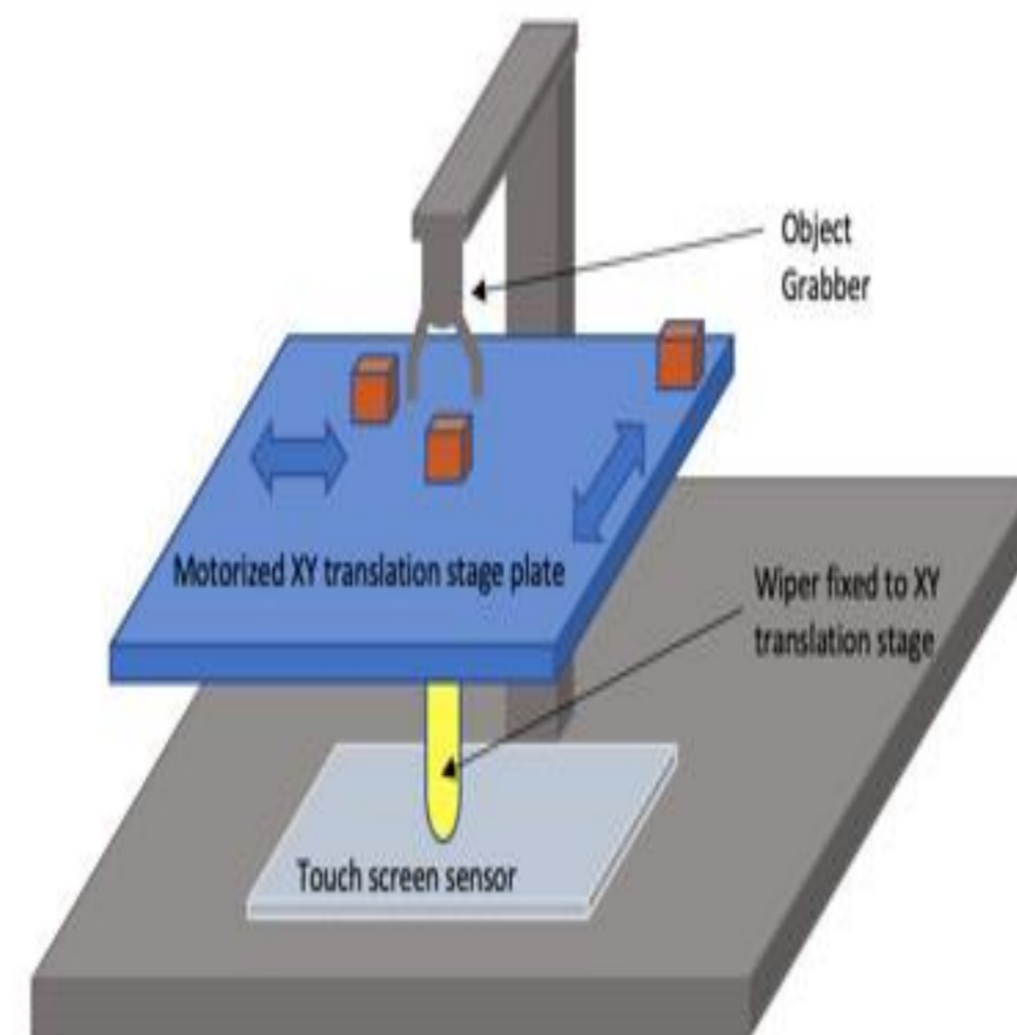
2D View Mapping

As well as the graph, which showed the user the recorded coordinates over time, 2D view mapping was implemented to give the user or an observer a clear view of what was happening. The coordinates of a virtual LED on the VB interface were mapped to the real-time touch screen coordinates, which moved the LED around the screen in real time and showed how the user was moving their finger across the touchscreen. This feature was implemented as a useful feature for any potential real-life applications, since it allowed the user to virtually monitor their location on the screen without using coordinates or looking at a graph. Potential applications include a cursor for a touch screen operated trackpad.

Novel Features

While the aim of the VB application was to read the Arduino data stream and present the object coordinates in real time with a 2D view, the application developed into an efficient control center with several novel features.

- Option to save plotted data to a .csv file, inspired by a similar feature in Excel.
- User could clear the data set or resume plotting where they left off after they disconnected from the serial port.
- 2D view mapping could be turned on and off using radio buttons



Advancements and Future Applications

To further enhance the impact of the 2D view mapping, further advancements on the project could focus on the VB application generating a virtual frame, separate from the rest of the UI where the virtual tracer for the real-time location of the touch screen could be contained.

The main industrial application discussed in the project was controlling the 2D motion of a moveable platform attached to a wiper and touchscreen. This could be applied below a fixed grabber and used as a pick and place mechanism. Potential applications include picking up IC's and placing them on the correct part of circuit boards.

References and Acknowledgements

Resistive Touchscreen Diagram: forum.espruino.com

Arduino Image: ie-rs.online.com

Pick and Place Mechanism Diagram: Dr Anthony Grant

I would like to thank Dr Anthony Grant for his help as a supervisor throughout my project.