

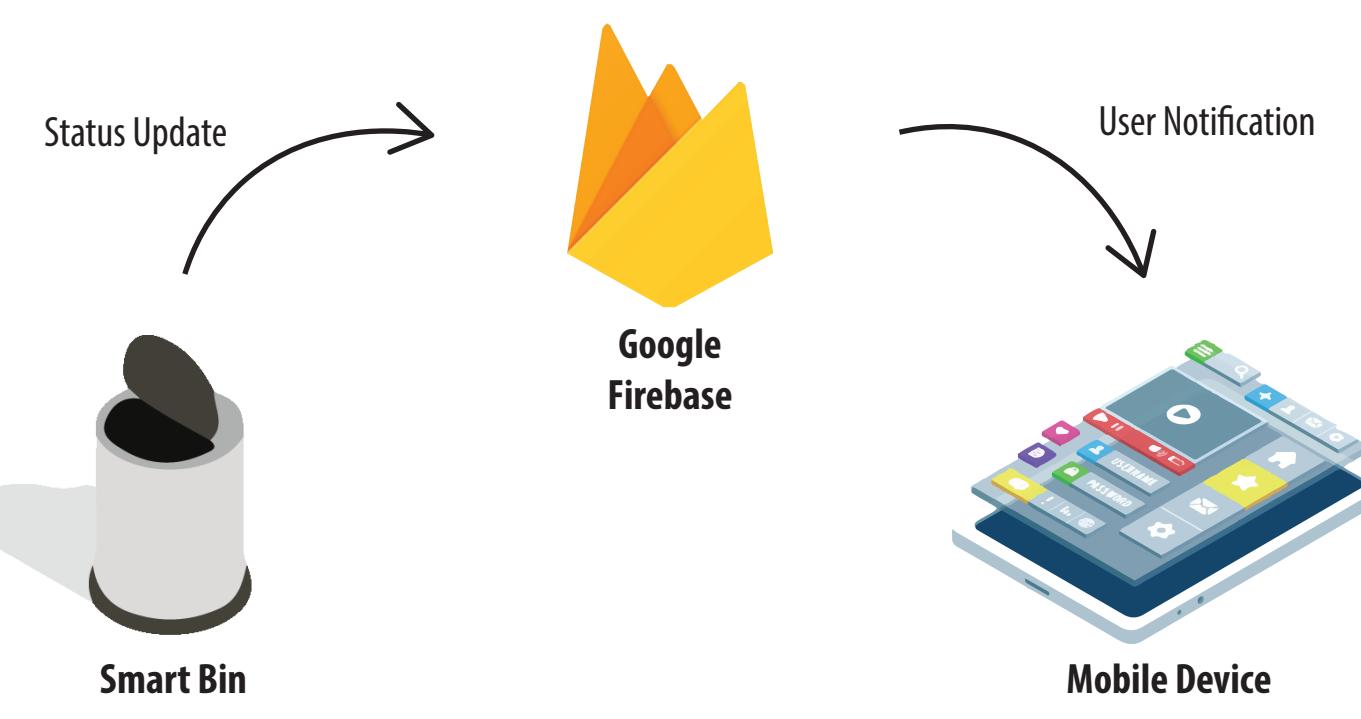
Bin There, Done That

10.09 The Digital World
F04 Group 7

THE PROBLEM

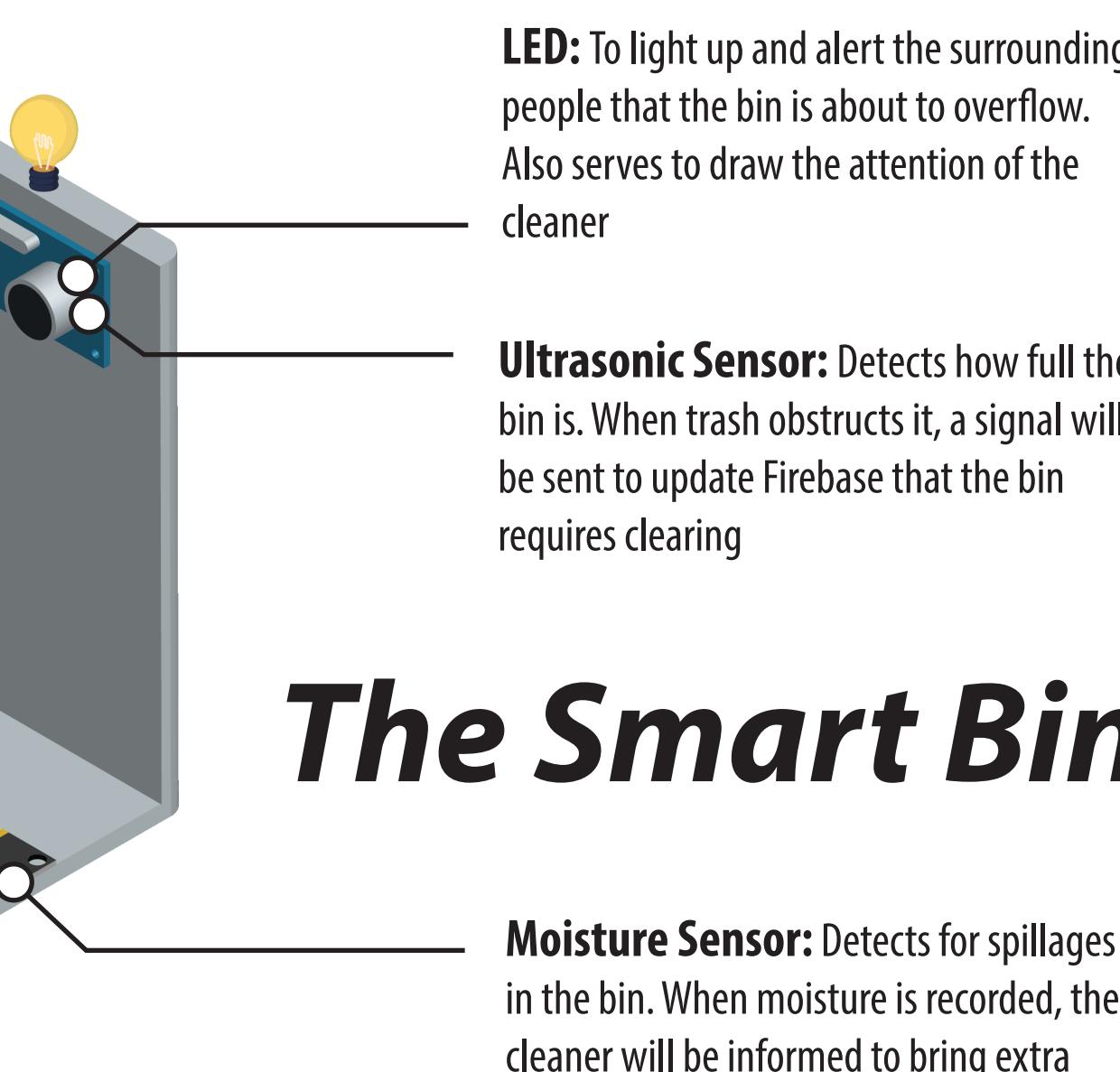
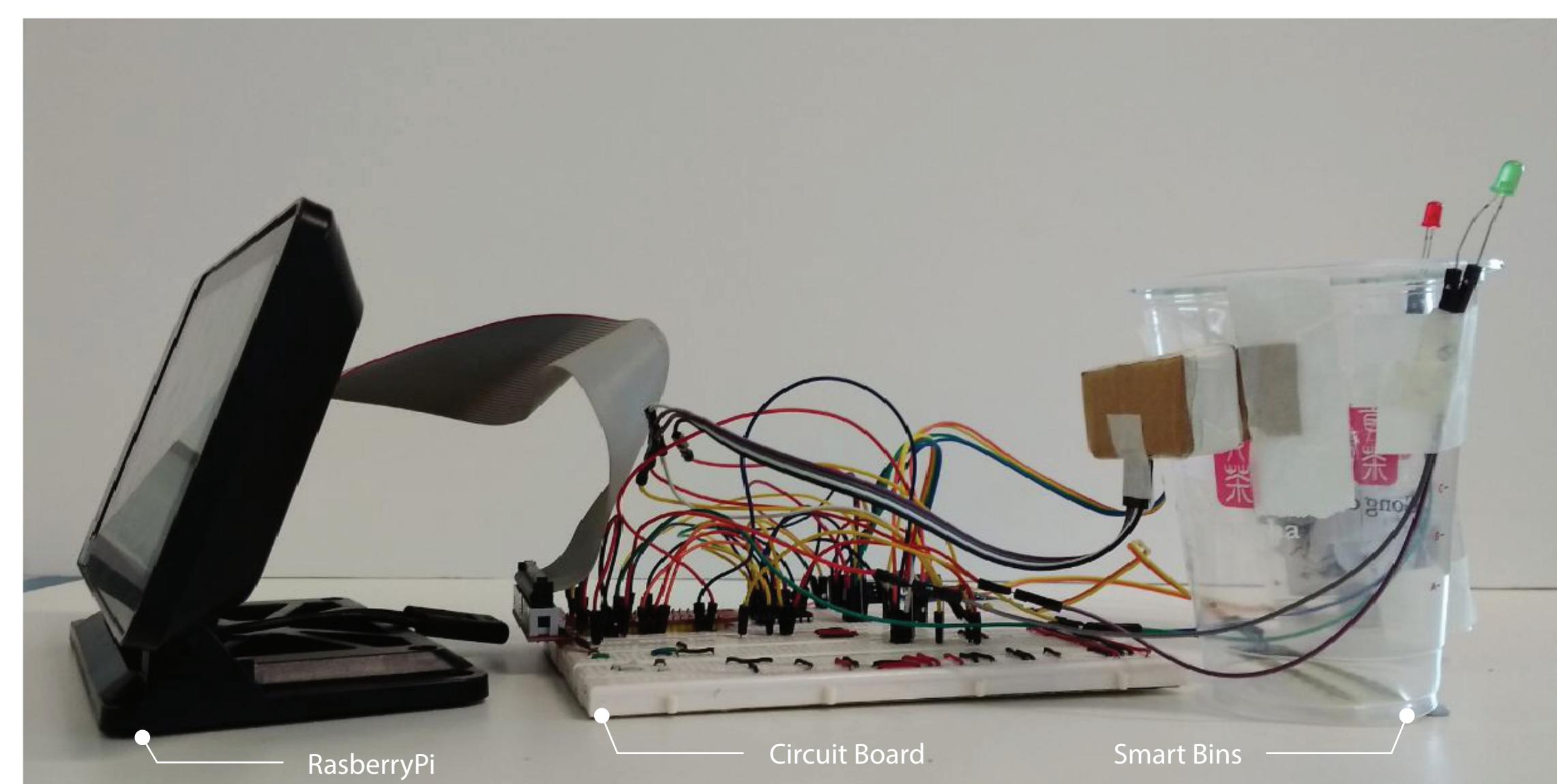
SUTD has a large campus, and to cater to a large student and faculty population, bins are placed at almost every bend along the walkways. Despite the large number of bins scattered around our campus, we continue to face the problem of overflowing bins, especially after an event. Cleaners in our school currently have no way of knowing when a bin is full, and also cannot predict which bins will fill faster than others due to the difference in population densities across campus. Therefore our group will tackle this issue of bin clearing in SUTD.

OUR SOLUTION



To make bin clearing more efficient, our team decided to create a smart bin, capable of detecting how filled it is and whether there is a spillage or not. Data collected from our bin will be used to update a Google Firebase database, and when the status of the bin changes, Firebase will notify the cleaner via a Telegram bot to inform him that the bin requires cleaning. The cleaner will be able to locate the bin through an our application on his mobile device, and his acknowledgement through the application will update the database as well. This new workflow saves time for the cleaner as he does not have to physically check the bins to know if they require cleaning, and allows him to focus on other undertakings.

THE PROTOTYPE & MOBILE APPLICATION



To obtain the status information of the bin, we will be using a RaspberryPi which will be placed remotely in the smart bin. The RPi will constantly check the information collected by the sensors, and will update the Firebase database accordingly.

To the right are schematics used to better understand our application - the screen transition table and diagram.

MACHINE LEARNING

As part of our group's future works, the Smart Bin will record the time taken for it to be filled, given the crowd density of a 20m radius around the bin. The crowd density will be gathered manually, and this data will be used to determine the relationship between the crowd density of an area and the time taken for the bin to be filled. We suspected that the two are related by a logarithmic relationship, and thus we linearized them to find a correlation.

Once we have gathered a large database with these data, our group plans to formulate a cleaning schedule for the cleaner when a new bin is placed in an area of known crowd density. We will be using predicted timings that the bin will be full as the timetable timings. We plan to gather the time taken for the bin to be full on different days of the week, including days with events (which will exponentially increase the crowd density of the area). This will help us create a stronger predictive model, and allow our predictions to be more accurate.

To the right is a graph that we have created using dummy data as part of our machine learning model, and the model information are displayed below the graph.

STATE	ACTION BY USER	NEXT STATE
HomeScreen	"Go To Building"	BuildingScreen
	"Exit"	Quit App
BuildingScreen	Selects a level	LevelScreen
	"Back"	HomeScreen
LevelScreen	Selects a bin	BinScreen
	"Back"	BuildingScreen
BinScreen	"Back"	LevelScreen
	Green	
	Yellow	
	Red	
	"Report Faulty"	
	"Back"	
	"I'll Go!"	
	"Back"	

Table 1: The generalized screen transition table that we used to develop our App

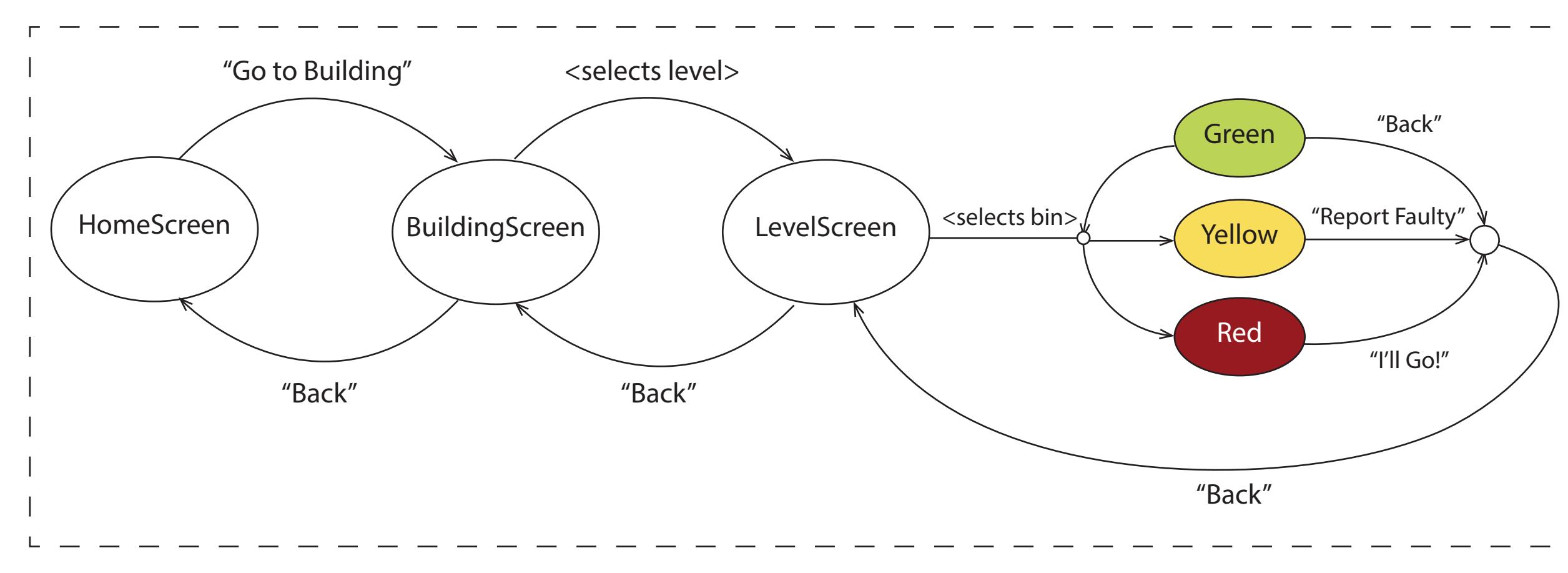


Fig 1: A visual representation of the screen transition table

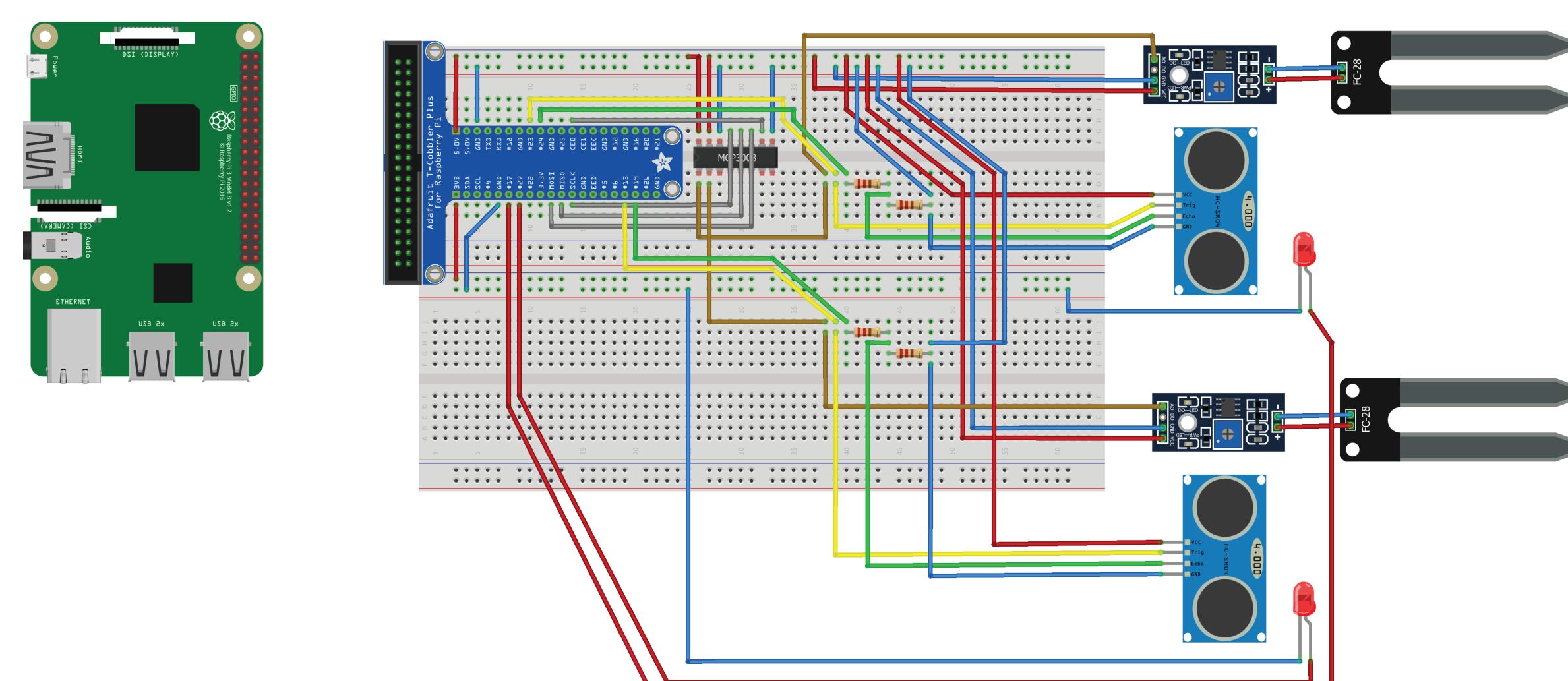
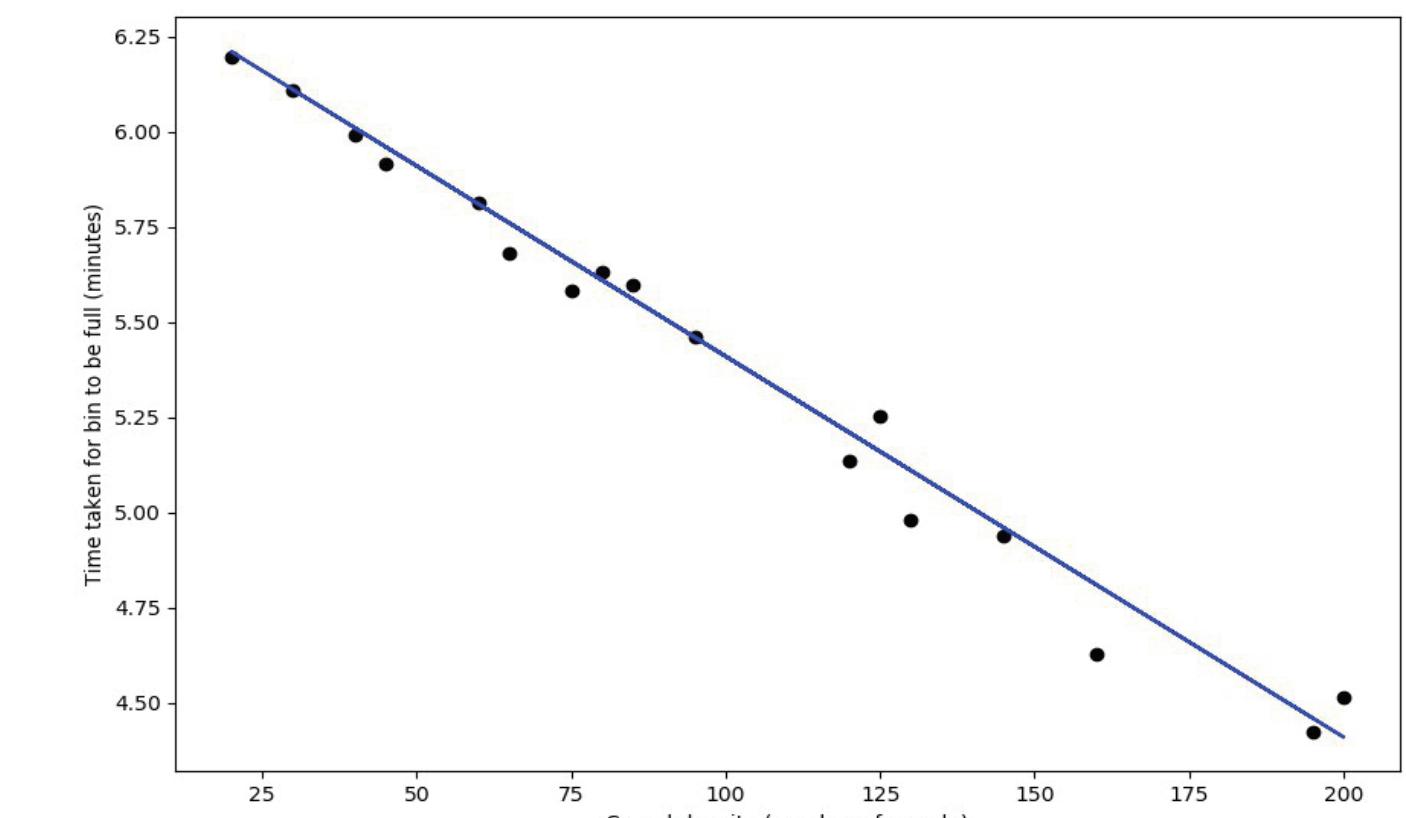
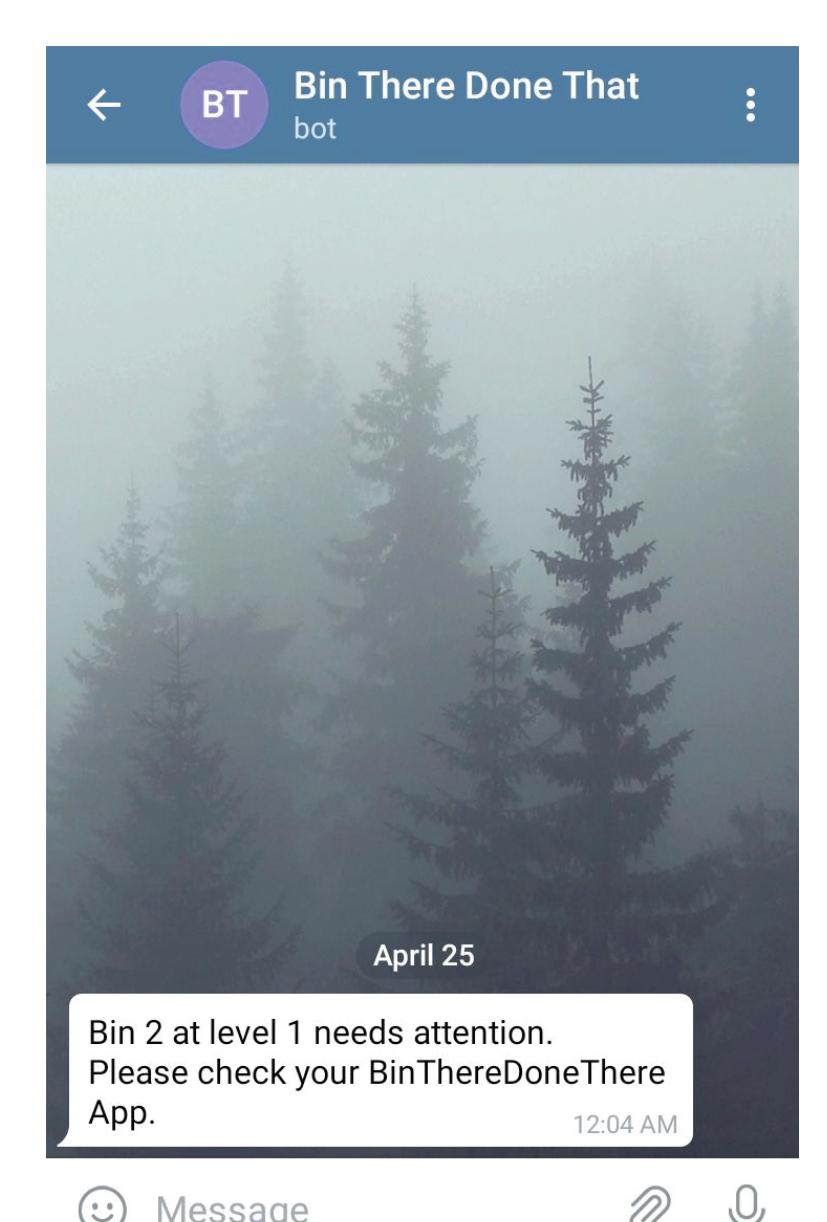


Fig 4: The circuit diagram for our prototype



When the sensors of the Smart Bin detects that the bin is approaching maximum capacity, has a spillage, or both, a status update is sent to Firebase. The LED attached to the bin will also light up to alert the people in the area of the warning status of the bin. Firebase updates the display of the mobile application, and sends a notification to the cleaner via a Telegram bot. The notification received by the cleaner will contain information about the bin that needs to be cleared, specifying which building and which floor the bin is located on. Upon seeing this notification, the cleaner will enter the application, and will click on the floor with the warning signal. He will locate the bin that requires attention, and will acknowledge that he is on the way to clean it by clicking on the acknowledgement button, "I'll go!". Such an acknowledgement will change the colour of the bin to yellow, to let other cleaners know that someone is on his way to fix the problem.

All bin settings (bin_color and LED power) will be reset when it is cleaned and cleared. Should there be a fault in the sensors (i.e. the bin colour does not reset after cleaning), the cleaner may choose to report the bin to the management.

BENEFITS OF OUR SOLUTION

Warning notification before it is fully-filled ensures no overflows

No need to constantly check, simply wait for updates

LED helps the cleaner to locate the bin easily

Manpower optimized as all users know the current status of bins in the building

Floorplan allows for easy location of bin

**Bin There,
Done That**

User-friendly, simplistic and clear

Informs cleaner what cleaning supplies he needs to handle the bin

