

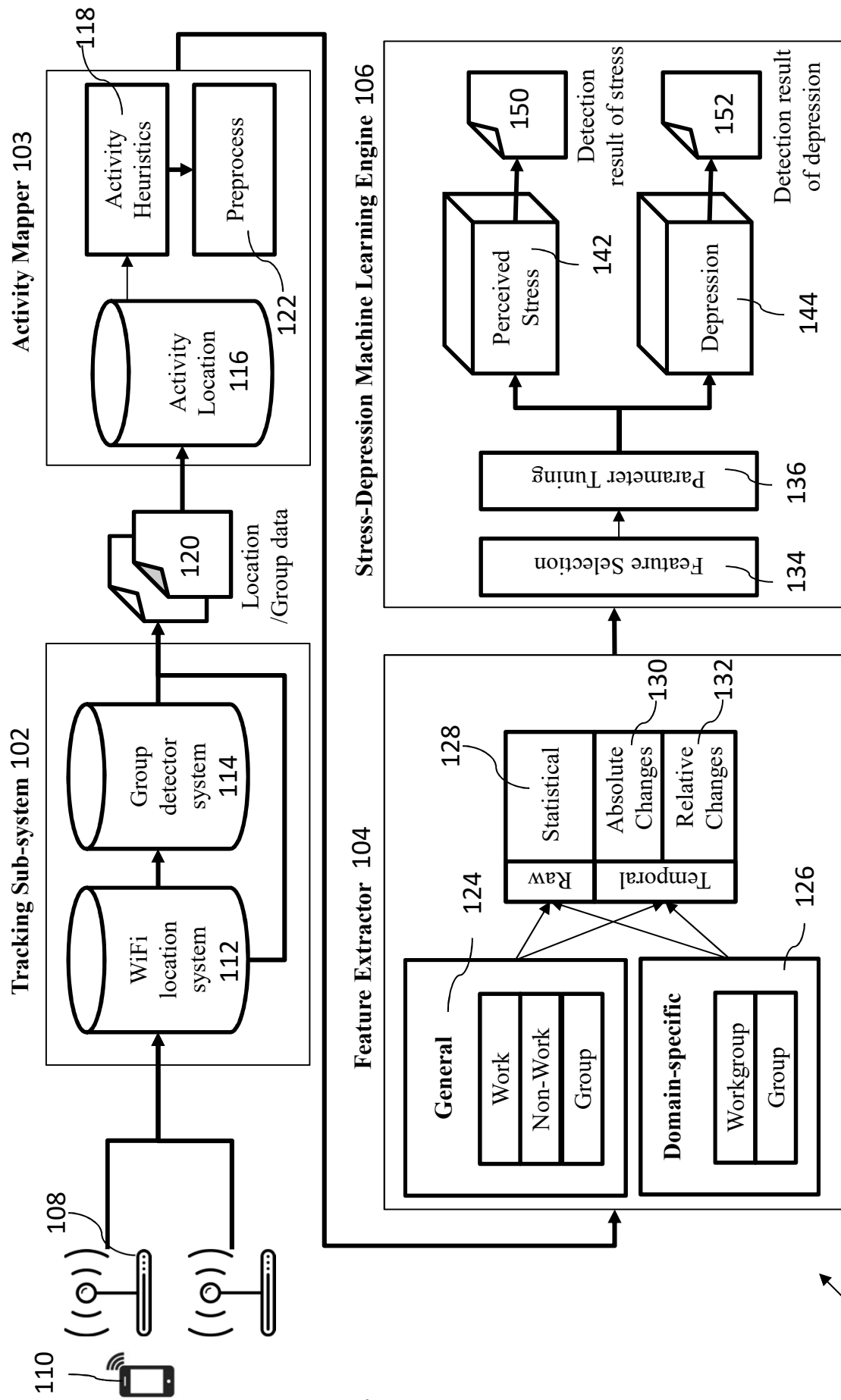


Figure 1

	Study_{SE} (primary)	Study_{validA} (validation 1)	Study_{validB} (validation 2)
Period	Fall AY2017, 81 days	Spring AY2017, 36 days	Fall AY2018, 81 days
Total	76 students (39 M, 37 F)	13 students (3 M, 10 F)	51 students (24 M, 27 F)
Active	62 students (34 M, 28 F)	11 students (3 M, 8 F)	35 students (15 M, 20 F)
Team	50 students	0 students	25 students
Individual	12 students	11 students	10 students
Age	19 - 25 (22 med)	20 - 24 (22 med)	19 - 26 (22 med)
GPA	1.64 - 3.84 (2.85 med)	2.90 - 3.99 (3.33 med)	0 - 3.78 (2.63 med)
Major	Information Systems (62)	Finance (1) Business management (9) Social Sciences (1)	Information Systems (31) Business Management (1) Economics (2) Accountancy (1)
Study year	Sophomore (62)	Sophomore (3) Junior (3) Senior (5)	Sophomore (12) Junior (9) Senior (1) Freshman (13)
Course	1. Software Engineering (62)	1. Social Entrepreneurship (11)	1. Software Project Management (8) 2. Interaction Design & Prototyping (13) 3. Computational Thinking (1) 4. Information Systems & Innovation (7) 5. Programme in Writing & Reasoning (6)

Figure 2

Welcome 683954!

You have no activity Due! Yay!!!

Week Number	Things to Do	Status
Week 5	AM - 18th Sept (7am-2pm)	☒
	PM - 18th Sept (6pm-12am)	☒
	AM - 21th Sept (7am-2pm)	☒
	PM - 21th Sept (6pm-12am)	☒
	AM - 24th Sept (7am-2pm)	☒
	PM - 24th Sept (6pm-12am)	☒
Week 4	AM - 12th Sept (7am-2pm)	☒
	PM - 12th Sept (6pm-12am)	☒
	AM - 15th Sept (7am-2pm)	☒
	PM - 15th Sept (6pm-12am)	☒
Week 3	AM - 6th Sept (7am-2pm)	☒
	PM - 6th Sept (6pm-12am)	☒
	Self Assessment 1 - 8th Sept	☒
	AM - 9th Sept (7am-2pm)	☒
	PM - 9th Sept (6pm-12am)	☒
Week 1	Pre Study	☒

Figure 3

	<i>Normal Stress</i>	<i>Severe Stress</i>
<i>Study_{SE}</i>	1529 (91%)	145 (9%)
<i>Study_{ScE}</i>	129 (98%)	3 (2%)
<i>Study_{MIX}</i>	944 (99%)	1 (1%)
	<i>Non-depressed</i>	<i>Depressed</i>
<i>Study_{SE}</i>	1140 (68%)	534 (32%)
<i>Study_{ScE}</i>	104 (79%)	28 (21%)
<i>Study_{MIX}</i>	615 (65%)	330 (35%)

Figure 4

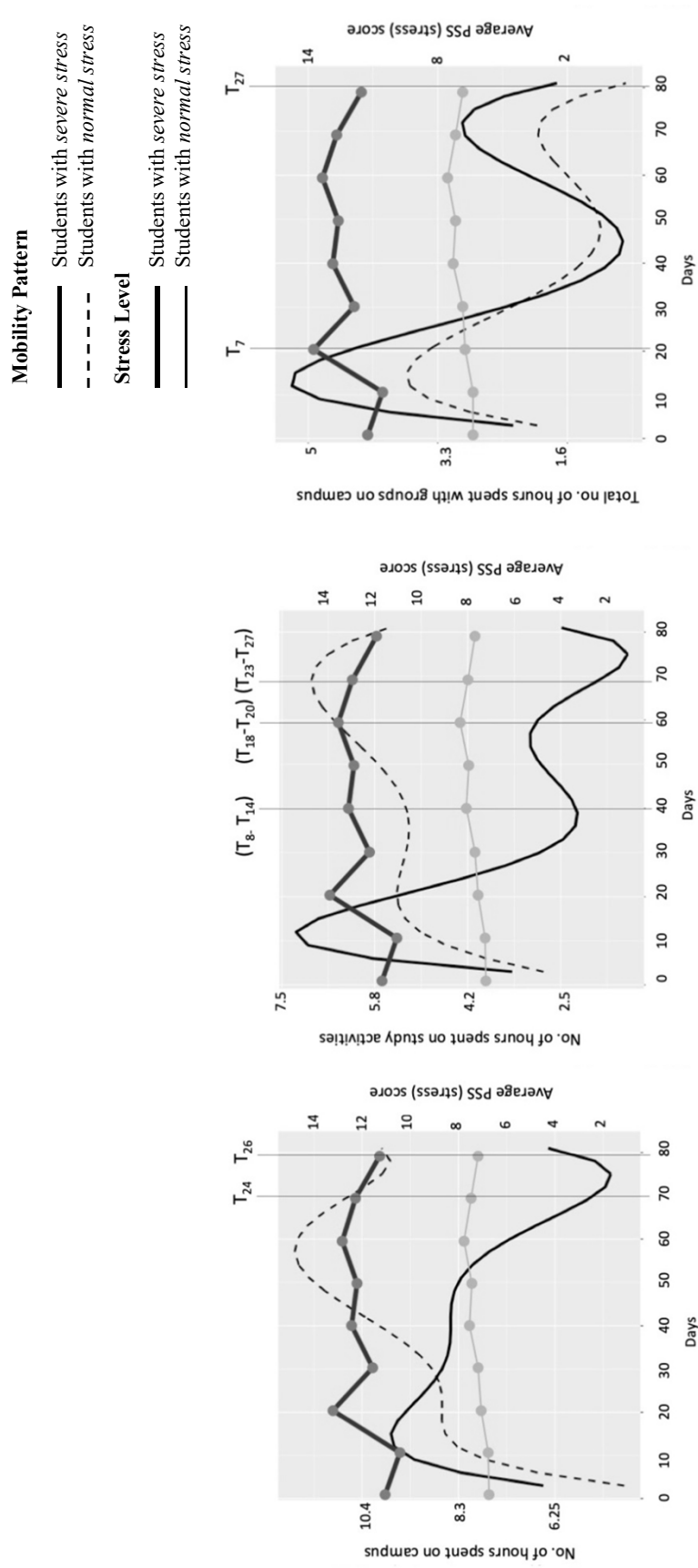


Figure 5

Feature Settings				Performance			
Model	Study Users	Method	Set	Type	Interval	AUC	TPR(%)
$Model_{S_SE}$	StudySE	Group 5-fold	General + Domain-specific	rel + abs	6-days	0.96	98.93
$Model_S$	All	Group 5-fold	General	rel + abs	6-days	0.97	96.01
$Model_{D+}$	All	Group 5-fold	General	rel + abs	15-days	0.88	91.21

Figure 6

	Logistic Regression (LR)	Support Vector Machine (SVM)	Random Forest (RF)
AUC	0.57	0.86	0.97
TPR (%)	69.77	79.41	99.60
TNR (%)	35.35	68.27	72.00
ACC (%)	37.35	69.27	74.44 (*)

(a) Results from using all features on different algorithms.
(*) indicates significance at $p=0.01$ level.

	<i>raw+rel+abs</i>	<i>raw</i>	<i>rel+abs</i>
AUC	0.97	0.91	0.95
TPR (%)	99.60	98.93	99.33
TNR (%)	72.00	59.65	69.49
ACC (%)	74.44	63.18	72.08

(b) Results from using different combination of feature types on chosen Random Forest algorithm; All (*raw+rel+abs*), Raw (*raw*) and Change (consists of relative change, *rel* and absolute change, *abs*).

Description	Type	varImp
Number of times engaged in <i>studying</i>	<i>abs</i> (Work)	100.0
Number of times being in <i>solo group</i>	<i>abs</i> (Group)	48.57
Number of times being in <i>solo group</i>	<i>rel</i> (Group)	40.22
Number of times engaged in <i>eating</i>	<i>abs</i> (Non-work)	33.68
Number of times engaged in <i>studying</i>	<i>rel</i> (Work)	32.38
Number of times engaged in <i>exercising</i>	<i>rel</i> (Non-work)	31.83
Number of unique building visits	<i>abs</i> (Non-work)	29.60
Number of times engaged in <i>transiting</i>	<i>abs</i> (Non-work)	29.21
Total time spent with <i>all groups</i>	<i>abs</i> (Group)	25.34
Number of times engaged in <i>attending lectures</i>	<i>rel</i> (Work)	24.67

(c) Top 10 features for detecting severe stress, using ROC curve analysis, and sorted by variable importance (varImp).

	3-days	6-days	9-days	12-days	15-days	18-days
AUC	0.95	0.96	0.89	0.82	0.89	0.83
TPR (%)	99.33	98.93	88.55	77.91	67.35	56.93
TNR (%)	69.49	75.54	84.62	87.86	90.27	91.52
ACC (%)	72.08	77.59 (*)	85.48 (*)	87.93	89.41	89.83

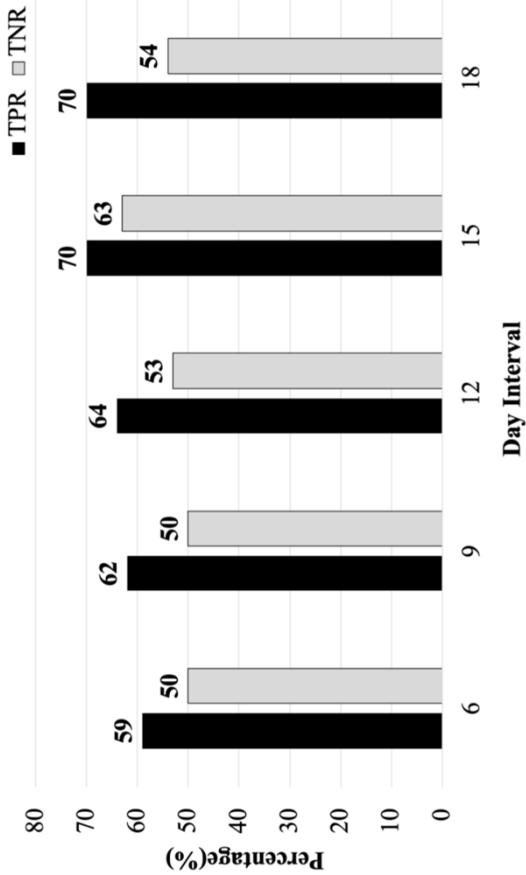
(d) Results from calculating chosen Change type (*rel+abs*) features on different time intervals; from 3 to 18-days. (*) indicates significance at $p=0.1$ level.

Figure 7

Method	Train	Test	AUC	TPR (%)	TNR (%)	ACC (%)
Train-Test	Study_SE	Study_Valid1	0.91	66.67	90.70	99.17
	Study_SE	Study_Valid2	0.94	100.0	81.25	81.27
Group5-fold (All pop- ulation)	Folds 2-5	Fold 1	0.98	94.44	86.81	87.06
	Folds 1,3-5	Fold 2	0.96	88.88	84.26	84.34
	Folds 1-2,4,5	Fold 3	0.97	98.64	80.88	82.09
	Folds 1-3,5	Fold 4	0.96	98.07	75.46	77.65
	Folds 1-4	Fold 5	0.96	100.0	76.38	77.65
Average			0.97	96.01	80.76	81.76

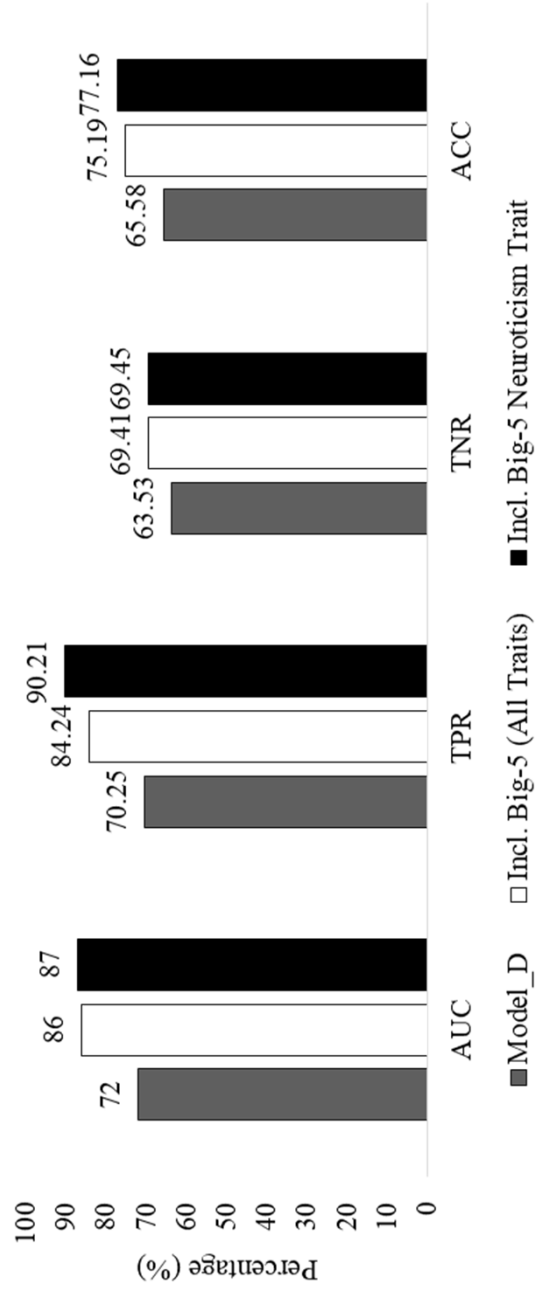
Summarised results for stress model, $Model_S$, on three different validations. $Model_S$ is a generalised stress model that excludes all *Domain-specific* features.

Figure 8



Results for $Model_D$ from calculating Change type (rel+abs) features on different time intervals; from 6 to 18-days.

Figure 9

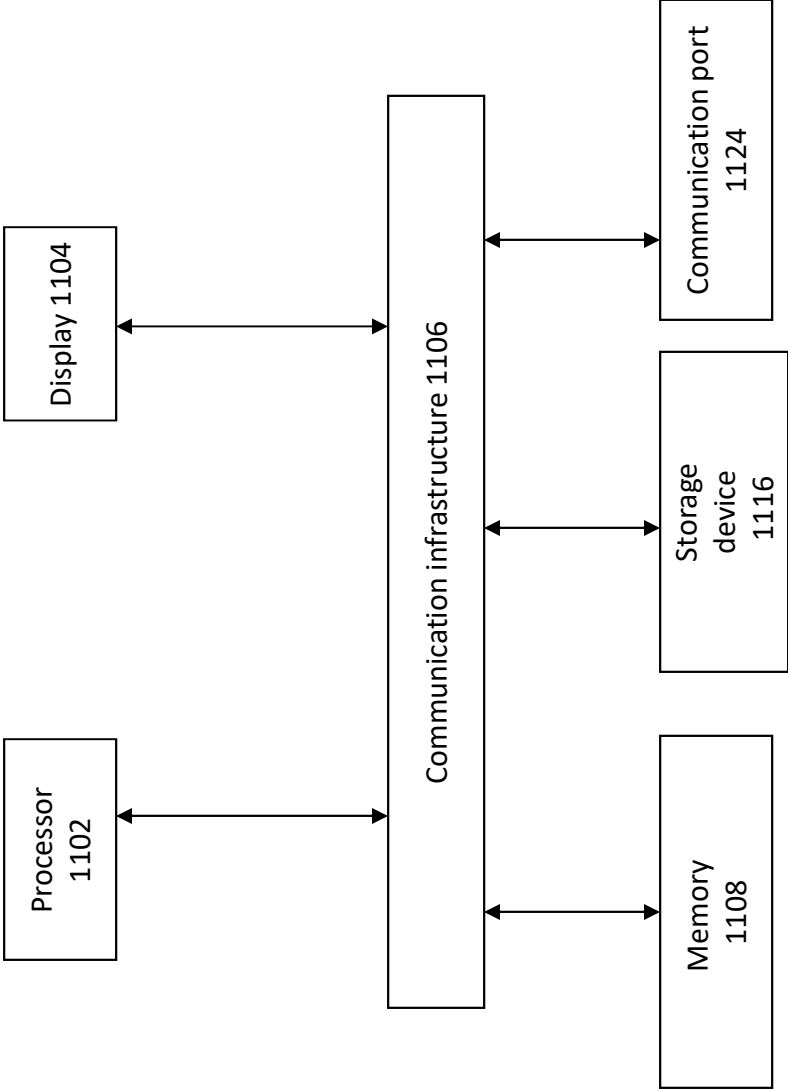


(a) Results from adding different optimisation features to the depression model, $Model_D$; (1) Including all 5 personality traits and (2) including only Neuroticism Big-5 score as feature.

Method	Train	Test	AUC	TPR (%)	TNR (%)	ACC (%)
Train-Test	Study_SE	Study_Valid1	0.41	57.14	47.12	49.24
	Study_SE	Study_Valid2	0.86	81.52	72.68	75.77
Group5-fold (All pop- ulation)	Folds 2-5	Fold 1	0.86	91.3	47.62	63.65
	Folds 1,3-5	Fold 2	0.93	92.66	76.82	79.96
	Folds 1-2,4,5	Fold 3	0.93	95.71	76.65	81.38
	Folds 1-3,5	Fold 4	0.88	90.87	68.69	77.28
	Folds 1-4	Fold 5	0.84	85.53	63.75	73.00
Average			0.88	91.21	66.71	75.06

(b) Summarised results for depression model with Neuroticism as optimisation feature, $Model_{D+}$.

Figure 10



1100

Figure 11